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THE PACIFIC CABLE.

Now that the election is over and the country has settled down once more to prosperous industry dissociated from nightmares, it is altogether likely that the Pacific cable will be pushed in Congress. We trust that its friends will be numerous and energetic. The details published as to the latest soundings are such as to afford great encouragement as to overcoming the physical difficulties of the task, while the political state of affairs and the rapid development of trade with the Far East promise an abundant traffic for the new system. By the time that the new cable is ready it will find an American network awaiting connection both in the Hawaiian Islands and in the Philippines.

We count upon seeing this cable made in America—a gutta percha cable—and on the use of American ships and men to lay it; but meantime the prayer may be devoutly breathed for better luck than has attended previous American submarine efforts, the sad details of which we will not here recapitulate. Let us in this work go to school humbly to our British friends, who have girdled the globe with cable; and then having learned the lesson we shall be ready to teach them in turn—some time in the next century.

CHARGING AUTOMOBILES.

The last two automobile exhibitions in New York City, as well as that held just previously in Chicago, have not only evidenced the popular interest in the subject but have shown how many are the advantages and possibilities of the electric automobile. So far as the exhibitions go, the electrics have stood up well under every test and comparison, but there are conditions to be met outside an exhibition hall, and it is on the street and road rather than the smooth floor or the level race track that the battle of the powers in automobilism is to be fought out.

The manufacturers of the electrics have made a gallant and successful fight, and their improvements are rapid and substantial. These would be more rapid if there were greater unanimity as to methods of standardization, and then probably they could count on better support from the central stations. Up to the present time the apathy of the central stations has been a disappointment to them, a disappointment which we share, although we do not forget that it was the same way when the power motor came along in practical shape. It had literally to be chocked down the throats of many central station managers, particularly those who do not read the journals of their industry, and therefore do not keep informed as to current advances in the art. If each of the two or three thousand managers were to order nothing more than a runabout in which to overlook their circuits, they would put themselves in a position to obtain better knowledge; they would afford an example to the neighborhood, and they would give material help to a new industry from which they in turn are soon to be the greatest beneficiaries, from the sale of current.

Society and well-to-do people everywhere are ready for the automobile. The attendance at the New York Horse Show this week is no better in quality than was that at the preceding show of the Automobile Club. Perhaps "society" will long continue to take an interest in the things of the breeding farm, and will not cease to take delight in a function that consists largely in sitting over a big stable, but it is undeniably interested in the swift and cleanly automobile and has already learned how to get lots of sport out of it. But in

automobilism, society is a small factor, and the central station manager can look for steady income from the new art in many directions. He may find that an automobile stage line will not compete with trolleys, but there is an abundance of travel to be got at 10 to 25 cents a trip in vehicles that are luxurious and are not crowded. And then there is the illimitable express and delivery wagon service.

ELECTRICITY ON BATTLESHIPS.

Elsewhere in this issue will be found an abstract of a paper by Naval Constructor J. J. Woodward, U. S. N., giving an account of the electrical equipment of the battleships Kearsarge and Kentucky, the results of which are extremely gratifying to those who have advocated the general use of electric motors aboard ship for auxiliary power purposes. The tests to which the electrical machinery was subjected were of the most searching character, and may be accepted as decisive in favor of the applicability of electric motors to shipboard uses. It is true that the ordeal of practical service is yet to be withstood, but in view of the thorough demonstration contained in the report as to the efficiency of the equipment as installed, failure will be apt to be considered as an indictment of the personnel in charge. There is no more reason why such an equipment as that now in the electrical department of the battleships mentioned should become inefficient through service than that the machinery in the propelling department should thus become inefficient. Consequently, any adverse result will point to an unsatisfactory situation existing with respect to the management of electrical machinery aboard men-of-war, and should reflect directly on those responsible for such a condition.

A striking part of the report consists in the showing made with respect to the economic efficiency of the generating plant. The steam end of marine electric generating plants has not shown up favorably in reports of a number of tests, in most instances the steam consumption being extraordinarily high. In the case of the two battleships, however, an economy is reported which is surprisingly good, but the description of the tests shows that the results obtained are worthy of confidence. The tests of the turret-turning equipment illustrated the extreme sensitiveness of the Ward Leonard system of electrical control, it having been found possible to move the turret through an angle so small that it corresponds to but two inches of an arc of a radius of a thousand yards. In this connection we may direct attention to a note in another column rectifying certain statements which have appeared in the newspaper press reflecting upon the efficiency of operation of the turrets of the Kearsarge and Kentucky. As will be seen, the defect which gave rise to the newspaper comment was of minor character and one easily corrected, and, moreover, had no relation to the electrical part of the turret equipment.

MOTORS IN WORKSHOPS AND FACTORIES.

An interesting topical discussion on this subject was held at the Franklin Institute in Philadelphia on the 15th instant. Although much has been said and written on the matter, yet so rapid has been and is its development, much remains which is yet unsaid. It is about fifteen years since electric motors first made their appearance commercially in factories. For some time they only found favor under special conditions. At the present time, however, they are not only entering machine shops in rapidly increasing numbers, but the tools themselves are specially modified in many cases to admit of being directly driven by the electric motor.

The main argument that used to be urged a few years ago in favor of electric driving, as against countershafts and belting, was the saving of the power wasted in countershaft friction. While this is still an argument, it is now, in the light of accumulated experience, only a minor argument in the motor's favor. It was stated in discussion by the superintendent of one of Philadelphia's leading mechanical industries, that when electric motors were first applied in their shops some years ago, at an expense of about $25,000, the reduction thereby effected in wages amounted to $700 weekly. This was mainly due to the additional facilities afforded for handling and shifting heavy machinery with but little intervention of manual labor. The removal of countershafts and belting cleared head room available for electric traveling cranes. In a similar manner, the use of overhead cranes and motor-driven machinery sometimes enabled twice as much machinery to be placed on a given floor space, with a corresponding economy and utilization of plant. The results described were said to have been so satisfactory that both management and workmen were unanimously in favor of the motor-driven tools.

A very encouraging account was also given of the introduction of motor-driven printing presses into the Government Printing Office at Washington. In this establishment thirty tons of paper are passed daily through the press, and with the electric system the work has been accomplished faster, better and cheaper than with the earlier countershaft driving.

One of the most important advantages of the electric drive is the flexibility and independence of the system as compared with that of the countershaft. In the latter system everything is comparatively rigid, and if a new belt has to be added during working hours, or if any derangement occurs at any part of the shafting, the entire system may have to pause temporarily, thus involving much aggregate loss of tool use and time while the change is being made. The motor-driven machine, on the other hand, not only acts as if provided with an independent engine, but permits of a much wider and more delicate range of adjustment in speed and power than where cone pulleys only have to be relied upon.

Of course, like every good thing, it is possible to go to undue extremes. Cases frequently occur where it is both economical and advantageous to operate several machines from a single motor, or to employ the group system of driving with a short countershafting, thereby reducing the first cost in motors. In exceptional cases the engine and countershafting may be the best after all, but there can be little doubt of the general benefit to be derived by electric motors in factories, and of the success which lies ahead of their use in increasing the productive power of the country.

Some discussion took place as to the relative advantage of alternating current and direct current motors for such purposes. This is, of course, a wide subject bearing much difference of opinion, and not confined to the arena of workshops, but extending to the arena of the general transmission of electric power. The facts are that induction motors are somewhat more expensive than direct current motors, and that the latter have more range of torque speed and torque efficiency. On the other hand, however, the alternating current motors have no commutators, and although the commutator has been much improved of late years, its absence is likely to cause a sigh of relief.

THE ENERGY OF CATHODE RAYS.

An interesting paper on this question, by W. Cady, appears in a recent number of the *Annalen der Physik*. The object of the paper was an experimental investigation into the energy reflected by the anode. If no energy were reflected from the anode on which the cathode rays impinge; or, if with reflection the impinging corpuscles were perfectly elastic, then the heat in joules acquired by the anode in a given time of bombardment should be

equal to the volt-coulombs supplied to the tube at its terminals. If, on the other hand, the reflected corpuscles only carry off a part of their energy, giving up the remainder on first impact, then the heat absorbed should be greater than the coulombs measured through the anode multiplied by the volts across the tube terminals. To measure the heat, both a thermopile and a bolometer were used, care being taken to shield this apparatus from disturbing thermal influences. Both methods of measurement seem to have agreed fairly well, and to have made the heat in joules about 20 per cent greater than the volt-coulombs. If this result is reliable, and if, moreover, as was measured by previous observers, a platinum anode reflects 40 per cent of the cathode streams impinging thereon, then it would follow that the reflected particles of matter left behind about one-third of their impinging energy, and carried off with them the remaining two-thirds after reflection. So many assumptions are, however, involved in the last conclusion, that it seems advisable to rest content with the result that the volt-coulombs or joules supplied electrically to a Crookes tube seem to be delivered up as impact heat upon the anode or walls of the tube.

SOME FEATURES OF POWER TRANSMISSION.

In another column will be found a description of a new transmission plant for the use of the mines on the Comstock Lode, which in several respects exhibits points of interest, particularly for engineers familiar only with Eastern practice. Even in its own country it is of rather unusual type since it actually uses pressure turbines under a paltry 85 ft. of head in a region of impulse wheels and heads of a quarter of a mile or so. The power plant is constituted in a general way common enough on the Coast; a low dam, a long conduit and an abrupt plunge down upon the wheels. But in this case the scheme is carried out in a way to make the tenderfoot engineer—he of hewn masonry dams and ship canals to the wheels—catch his breath. For while the hydraulic system starts in in very orthodox fashion with about forty rods of canal, it goes on into more than a mile and a half of open timber flume and ends in a wooden penstock. The fact is that the East is far less adroit in hydraulic expedients than men brought up in a country netted with irrigating ditches. Experience has taught them that where freights are high and lumber cheap a timber flume is both cheap and serviceable. It is durable, too, to a far greater extent than the casual observer would suppose. The economic theory of its use is that the extra depreciation and repairs on a wooden flume amount to considerably less than the interest on the extra investment pertaining to an iron or masonry flume. And in a precisely similar way there are many cases in which a penstock of stout redwood staves is just as effective as, and far cheaper than, a steel one, which would have to be transported at enormous freight rates and put together on the spot.

Another interesting feature of this plant is the method taken to secure good regulation at the wheels. The type of governor used is well known for its sensitiveness and efficiency, but a penstock 160 ft. long, even with a downward pitch of about 30 degs., is a very serious handicap in regulation. On lower heads one can use a standpipe for relief, but in this case it would have to be of the dimensions of a tower, so as the governor shuts the water off the wheels it simultaneously turns it into a spillway, thus holding the velocity of the stream nearly constant. Of course, it wastes water, but when no storage is attempted, there is no good reason why it should not, and the device does its work, which is, after all, the thing most essential.

As to the line, few Eastern plants indulge themselves in fine squared poles, but on the Coast things are different. In the first place, California redwood is a splendid material for poles, and it is easily had in large logs. In the second place, it often happens, whether in this case or not we do not know, that the freight rates are so high that the better stowing of squared poles on the car and the shorter haul for redwood, lowers the total cost per pole delivered to a point that makes round poles an unwholesome luxury. Unless one has actually installed plants in the Far West, he has no adequate idea of the terrors that lurk in a freight tariff.

But the most interesting innovation in this plant is the basis upon which power is sold, for the charge is based squarely upon maximum demand as determined by recording instruments. Metering power in a general sense is common enough, and there has long been a keen realization on the part of station managers that in some way or other the maximum power demanded should be a factor in the price. On the contract system of selling power this matter is generally adjusted by basing the nominal horse-power sold on the capacity of the motor installed, and fixing the horse-power rate on a sliding scale based on the character of the service. But, although this arrangement had the elements of fairness if properly administered, it led to endless disputes over the rate, and sale by contract has steadily fallen into disrepute, even if circumstances have not justified its complete abandonment. Ordinary meter service takes account only of the total power furnished during a given period quite irrespective of its fluctuations, while every station manager knows that steady loads are to his advantage and very variable loads a serious disadvantage. Under the present scheme the maximum demand for power during five minutes in case of ordinary motors or during two minutes in the case of hoist motors fixes the horse-power rating for the month in which it occurs, and the price per horse-power is arranged by an ordinary schedule. So long as the service is not of too complex character the plan should work fairly enough, and the self-registering wattmeters, while a bit complicated, ought to do the work well. In general service, however, the plan seems likely to lead to frequent disputes. As a matter of equity the man who calls on his motor for a heavy output a few times a month should not be held accountable for the same service as a man who makes the same demand several times a day, for the casual overload may or may not come at an unfortunate moment of general high load, while an often repeated overload is pretty certain to join with others of its kind in giving the plant a very bad quarter of an hour at some very inconvenient time.

What is really wanted is a simple and easily operated scheme of charging one rate for the steady component of the load and another and much higher one for the fluctuations which increase the load. Two-rate metering in the ordinary sense does not quite meet the exigency, for it merely deals with the peak during fixed hours. Possibly one might make a fair approximation in the case in hand by installing an ordinary integrating wattmeter as well as the recording meter and then charging a regular tariff per kilowatt-hour by the former, plus an excess rate by planimeter from the latter. Thus, each customer would pay at one rate for his average load and at another for his load in excess of that average. Power stations operating induction motors are always in rather a quandary about charges for power, by reason of the large wattless currents sometimes found. Surely a person who cherishes a motor with an atrociously bad power factor ought to pay something for his violent calls for current. It may be that this could be met in a similar fashion by installing both a wattmeter and an ampere-hour meter, and charging on one tariff by the former, and on another for the wattless current as determined by the latter. Certainly capacity demanded by a customer should in some form be subject to regular charges.

Lieutenant F. Jarvis Patten.

F. JARVIS PATTEN.

THE death of Lieutenant F. Jarvis Patten, which, as announced in our issue of last week, occurred suddenly in New York on Nov. 12, removed a striking personality from the electrical field. Of great intellectual ability, Lieutenant Patten also possessed the inventive faculty in a high degree, and that his name is not more closely connected with electrical development in the past fifteen years is to be ascribed largely to a Bohemian disposition which militated against continuity of effort. With Lieutenant Patten to invent was in itself a keen pleasure, and the interest taken in a given subject was rather in proportion to the opportunities it afforded for the exercise of the inventive faculty than in consideration of its commercial possibilities. To this handicap should be added a personal disposition which rendered the attractions of a Bohemian existence superior to the demands of a normal work-a-day life; a disposition to which he only rose superior when an idea for an invention entered his mind.

Lieutenant Patten, who was born at Bowdoinham, Maine, in 1852, came of a family for a number of generations connected with the shipping industry. His grandfather, who served as a commissioned officer in the Colonial forces before the Revolution, constructed the first ship built in Maine, and his father, the late Captain Jarvis Patten, was the first Commissioner of Navigation of the United States. From early youth, Lieutenant Patten enjoyed exceptional educational advantages. His father, who was the possessor of one of the largest private libraries of the day, had planned a classical education for his son. The youth having shown at an early age a strong talent for drawing and constructive design, this development was persistently discouraged and he was put closer than before at Latin and the classics, for which he displayed no great fondness. From the age of thirteen to seventeen, he was kept at school on the European Continent, and returned to his native land, conversant with the French and German languages but having no knowledge whatever of the physicial sciences. Soon after he was sent to college, more because of deficiencies in Greek than for any other reason, and the selection of Cornell University proved a great factor in his career, for here he drifted into the scientific course and became an earnest student. A frolic in the third year of his course severed his connection with this college, and while at home under sentence of suspension for a term, he was offered and accepted a cadetship at West Point. Graduating in the class of 1877. he was ordered West, and during the Nez Percé campaign was an aide on the staff of General O. O. Howard.

While on a visit to the East in 1883, the marked development in all electrical applications turned his attention to this subject, to which he thenceforth became devoted, and in 1887 he resigned from the army in order to give to it his entire attention. While in the service, he commenced inventing, one of the subjects being a self-recording electrical target. His attention having been directed to telegraphy, he devised a synchronous multiplex system in which the synchronous properties of the alternating current motor were first applied to rapid telegraphy. The system appealed to some capitalists, and for several years Lieutenant Patten was connected with a company organized to put it into commercial use. The same difficulties were encountered, however, as have checked the introduction to this country of rapid telegraphy, and the inventor finally turned his attention to other subjects.

For the purpose of investigation, he equipped an electrical laboratory in which he had several forms of alternating current motors running before this type had entered into commercial use, and during this period he took out a large number of patents on motors and other alternating current apparatus. For a year or more he turned his attention to the invention of a telephone repeater, several forms of which he patented. During the Spanish-American war he got up a system for the use of calcic carbide as an explosive, and just before his death he was engaged in perfecting a position finder for ships.

For the past several years Lieutenant Patten's attention was largely devoted to the electric furnace, and at the time of his death he was vice-president of the Columbia Carbide Company, of which ex-Governor James E. Campbell, of Ohio, is president.

Electricity on the New York Elevated.

At the annual meeting of the Manhattan (Elevated) Railway Company, President George J. Gould said: "The annual report to the stockholders shows the satisfactory growth and results of the company's business for the year ending Sept. 30. The electrical installation is making excellent progress. The heaviest work at the main power station at East Seventy-fourth Street is completed, and the superstructure is being rapidly erected in anticipation of the first arrivals of machinery, due for delivery next month. The first electric train is completely equipped, and, through the courtesy of the officials of the Metropolitan Street Railway in furnishing us with the necessary power, it will be put in operation on our Second Avenue line without delay.

"The company's general improvement and enlargement of facilities other than the change of motive power will begin to produce results in the very near future. The first stretch of the Fordham extension beyond Tremont will be ready for trains in a few days, giving entrance to the new yards at One Hundred and Eightieth Street, with a capacity for 325 cars. The new line from this point to Fordham will be finished early in January. Our plans contemplate the extension of express service from Eighty-fourth to One Hundred and Twenty-ninth Street, on the Third Avenue line, materially shortening the running of express trains between Harlem and the lower part of the city. This improvement we expect to put into effect within the next thirty days. Generally, I may say that the outlook for the Manhattan system is most encouraging."

The road carried during the year 183,788,851 passengers, a gain of 6,584,293 over 1899. The operating expenses under Mr. Baker were cut down from 56.69 to 52.21.

Mr. Steinmetz Before the New York Electrical Society.

The New York Electricial Society held its 209th meeting at the College of the City of New York on Nov. 16, when before a very large and most appreciative audience Mr. C. P. Steinmetz delivered a lecture on "Alternating Current Engineering." It may be said at once that no more valuable or interesting lecture has ever been delivered before the society. In the course of about an hour and a half, supplemented by replies to questions, Mr. Steinmetz treated of the development of the alternating current for power and lighting purposes, its application for long-distance work; its relation to continuous current local supply; questions of railway work; frequency, voltage, regulation, etc. While handling the subject broadly, Mr. Steinmetz presented a number of new facts and cleared up many obscurities in regard to the nature and use of alternating current. At the close of the lecture and of the discussion, in which Messrs. Dunn, Henshaw, Burnett and Williams participated, Mr. Steinmetz, in response to a unanimous request, promised to put the lecture in written form so that it may be published by the society.

The following named gentlemen were elected to membership: H. S. Arnold, C. F. Splitdorf, G. H. Hill, J. S. Humbert, Chas. Arthur Hannan, David H. Darrin, M. R. Hutchison, C. Howard Parmly, C. W. Obert, Robert A. Fliess, Howard Richards, Jr., Edward R. Knowles, all of New York City; H. G. Osburn, Hoboken, N. J.; Harry B. Naylor, Newark, N. J.; W. W. Morse, West Orange, N. J.; E. M. Archibald, Ampere, N. J.

Alaskan Telegraphs.

Unofficial information received in Seattle, Wash., indicates that Capt. Abercrombie, who is engaged in building a Government telegraph line from Valdez, Alacka, to the Yukon, and in exploring the country for the War Department, plans to continue operations this winter. In order to clothe his men properly for outdoor work in the interior portion of Alaska, Capt. Abercrombie has made a request on the Quartermaster for heavy woollen clothing, part of which has already been forwarded to him at Valdez, and the remainder is soon to be shipped.

Electric Cars in London.

A despatch from London states that on Nov. 20 the London County Council decided to take steps to institute an electric car service throughout the metropolis.

Electric Power on the Comstock Lode.

BY WYNN MEREDITH AND WYATT H. ALLEN.

THE history of the early discovery and subsequent working of the famous Comstock Lode, "the great silver vein of the world," is so well known as to need no repetition. It is situated on the east flank of the Sierras at Virginia City, Nev., and is tapped by several shafts and the famous Sutro tunnel from which hundreds of millions of dollars in gold and silver have been extracted. Up to the present time, mining, milling and pumping operations have been carried on by steam power, using pine wood for fuel, costing from $8.50 to $15 per cord. Most of the milling was done on the Carson River, some 15 miles from the mines, where water could be obtained at a small cost, the ore being hauled at first by wagon and later by railroad. A small quantity of water is brought to Virginia City through 40 miles of flume, and sells for $20 per miner's inch per month. Mine pumping is now done with this water in a jet pump under a head of 2400 ft.

During the summer months of 1899, the Truckee River General Electric Company was incorporated for the purpose of erecting a power plant on the Truckee River, in California, to furnish electric power to the Comstock mines, and in August of the same year an agreement was entered into by the electric company and the Comstock Pumping Association, an association composed of the several mining companies, by terms of which the electric company is to construct a power plant and to sell power to the mines, and whereby the Pumping Association agreed to advance one hundred thousand dollars as a bonus to the electric company, the amount to be rebated for power delivered after the completion of the work. The contract is unique and interesting in many respects, but the chief point of technical interest is contained in the clause providing for the measurement of power delivered. This clause asserts that current and power shall be measured by recording instruments at the sub-station, and that the number of horse-power furnished to the mining companies shall be determined by the maximum demand reading of such recording instruments; and in determining what is the maximum demand during any month, the highest reading of the instruments for any period of time exceeding five minutes shall be taken, except where any motor directly connected to a hoist be used, in which case the maximum demand shall be determined by the highest reading of the meters for any time exceeding two minutes.

The Truckee River heads in Lake Tahoe and flows northeast through California and Nevada. It is fed by the snows of the Sierras, its rise and fall being approximately 8 ft.

The electric company's dam is situated close to the mills of the Floriston Pulp & Paper Company, at Floriston, Cal., on the main line of the Central Pacific Railway. It is of timber crib construction, rock filled and sheathed with double two-inch planking. The main structure is 142 ft. in length and 7 ft. in height, the cribs at each end being built up about 10 ft. higher as a protection to the abutments in time of high water. The head gates are set into the head of a canal on the north bank of the river above the dam. They consist of five openings separated by walls of 12 x 12 timbers built up into cribs above and at the sides. The gates proper are of wood sliding in angle-iron guides, and are operated by means of screw stems and hand wheels.

The canal is about 600 ft. in length and 20 to 100 ft. wide, forming a settling pond, and providing for the water a means of quiet entrance into the flume. It was originally the old river bed, requiring but little excavation to make it fit for use as above described. At the lower end the water flows through a finger-bar screen into the head of the flume, which is 28 ft. wide at this point, converging in a length of 40 ft. to its normal size. The finger-bars, scour gate and spill-way are maintained in place by crib work similar in construction to that in the dam.

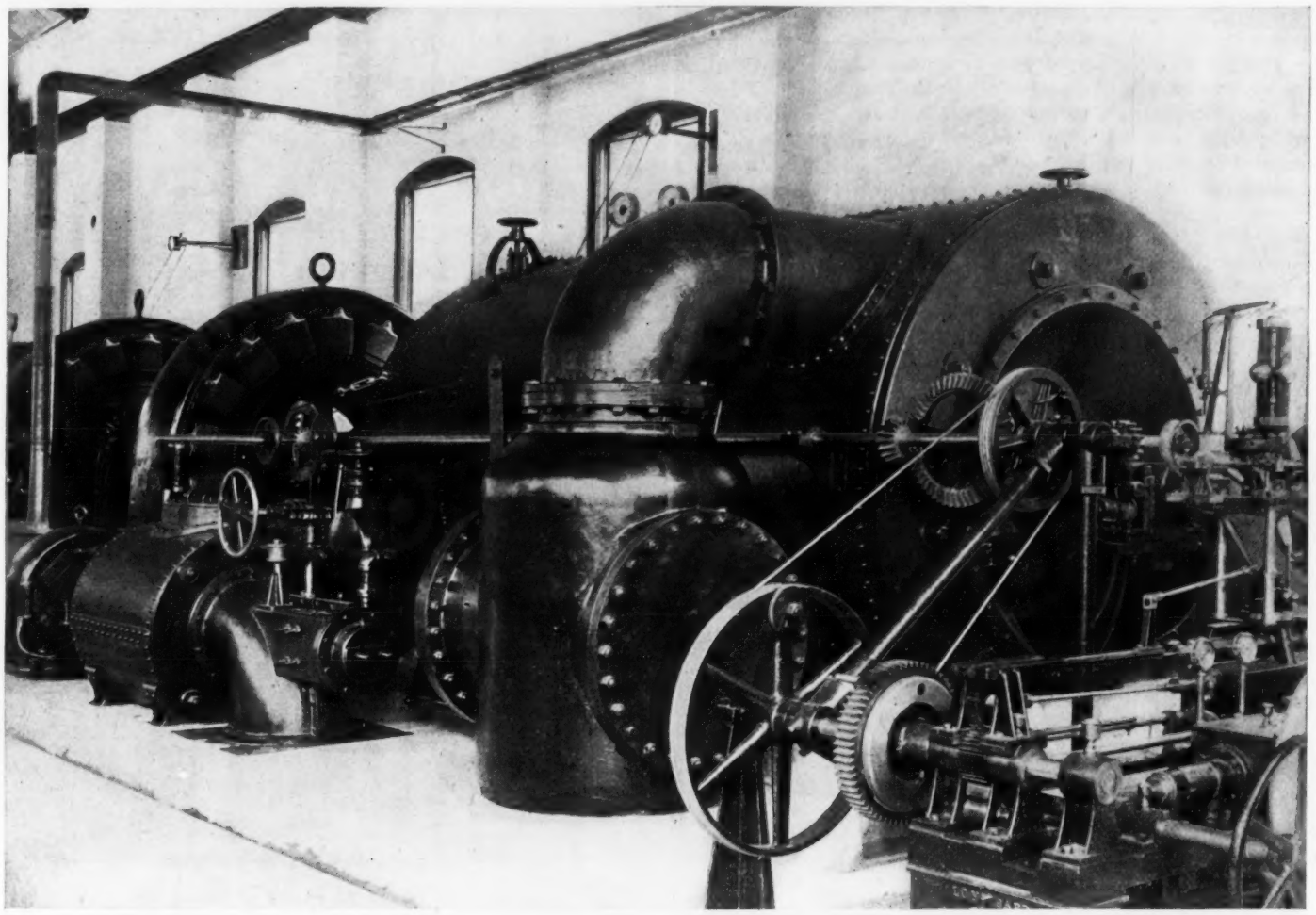


FIG. 1.—ONE OF THE GENERATING SETS, SHOWING GOVERNOR AND BALANCED VALVE.

The flume is about 8600 ft. long and is 6 ft. 8 in. by 10 ft. in the clear, of native pine, carrying 300 cu. ft. of water per second, with a depth of 6 ft. in the flume. The boxes are 12 ft. in length, supported on bents spaced 16 ft. centres, with two sets of four intermediate posts. At two points on the flume line are spill gates set in the sides of sand boxes below the bottom of the flume. In case of damage to any part of the structure, the water may be turned out at once through the nearest set of spill gates without the delay necessary to operate the head gates at the dam. For 200 ft. back from the pen-

stock a spill flume 5 ft. 8 in. wide is built at the side of the main flume on a heavy grade to take the spill water when the penstock gates are closed. The penstock is of pine, 36 ft. long by 21 ft. wide, stayed with three-quarter-inch iron rods. Inside it is divided by a bulkhead into two compartments, from one of which two pipe lines lead. The flow of water to each pipe is controlled by three wooden gates in the bulkhead, operated by hand wheels from a platform above.

Water flows to the wheels through two lines of wooden stave pipe, 72 ins. inside diameter and 160 ft long. The staves are of redwood, varying in length from 10 ft. to 24 ft., and bound together by means of five-eighth-inch round steel bands. Where joints come in abutting staves, a metallic tongue of one-eighth-inch band iron is fitted into the ends of both. A few feet from the power house the wooden stave pipes are wedge-jointed to steel pipes riveted onto the wheel cases.

Below the penstock, close to the river bank, stands the large brick power house, the length of which inside is 88 ft. and width 31 ft., the proportions, from an architectural point of view, being relieved by a hip in the roof, projecting toward the river. The foundations and tail races are of concrete and the roof of corrugated, galvanzied iron, supported on steel trusses and wooden purlins. The interior is well lighted by windows of ample size. All low potential cables are carried in 6-in. ducts of glazed sewer tile, embedded in the concrete floor, and the station is served by a 12-ton hand crane supported on heavy I-beams running the length of the building on brick pilasters projecting from the walls and spaced 10 ft. centres. The tail races are 18 ft. in depth, with roofs formed by springing concrete arches between steel I-beams, and concrete floors protected by heavy planking 6 ft. below the level of minimum water in the river.

The main water wheel equipment consists of two pairs of 27-in. horizontal McCormick turbines, each pair capable of developing 1400 horse-power at 400 r. p. m. under a working head of 84½ ft. The main body of the wheel casing is of heavy plate steel, and the buckets

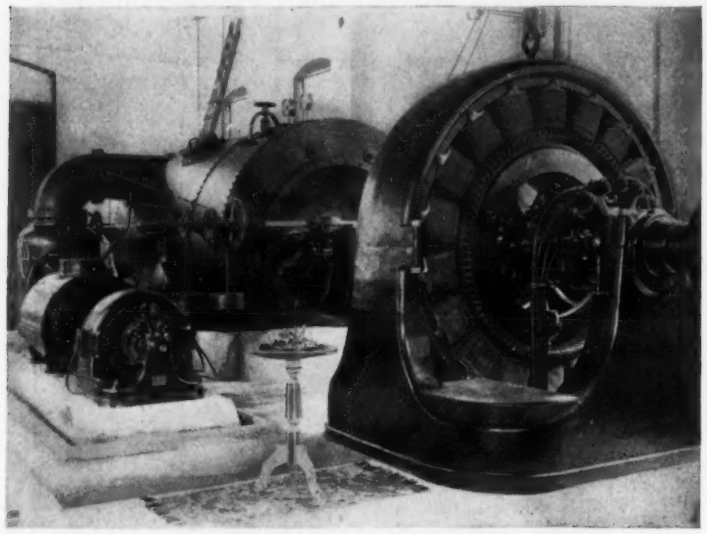


FIG. 2.—ONE OF THE GENERATING SETS.

of the runners are of cast-steel with heavy bands around them. To each wheel case are riveted heavy cast-iron brackets, the bases of which are planed to fit similar brackets on the supporting I-beams. Each pair of turbines discharge into a cast-iron draught box, in the centre of the casing, to which is riveted a single draught tube. The tubes taper in about 20 ft. of length from 54 ins. to 72 ins. at the lower ends and reach tail water at an angle of 45 degs.

Each set of turbines is provided with a type "B" Lombard governor, operating the gates, and also a Ludlow balanced valve operated by a wire rope passing over sheaves, one mounted on the shaft of one of the gates, the other on a short countershaft. The lever operating the Ludlow valve is placed between sheaves, and the wire rope fastened to it in such a manner that the revolution of the gate shaft in opening or closing the gate, closes or opens the valve in the opposite direction, thus maintaining an approximately constant velocity of flow in the pipe lines, whatever variation of load may be taking place. The valves discharge into the tail races of the wheels, and are connected to the wheel casing by a short length of steel pipe. At first sight this arrangement may appear wasteful, but in reality, since no storage of water is necessary, were the water not wasted through the valves at time of light load, it would merely spill over the flume or dam. The great gain in regulation due to constant velocity can only be appreciated upon considering the time consumed in overcoming the inertia of the large mass of water in the pipes.

To each set of wheels is coupled one 750-kw Westinghouse three-phase, 500-volt generator, the generators themselves being so arranged that they can readily be direct connected by a rigid coupling; thus both may be driven by one wheel set. The flexible couplings between generator and water wheel are of a type designed some years ago by the electric company's engineers, and are now largely in use in California. They consist of disks keyed on the shafts of the generator and wheel, each disk having four steel pins. The pins on the two flanges are connected through leather links, the coupling, as a whole, forming a most satisfactory means of flexible connection.

The exciters—two 22½-kw machines of the multipolar type—are driven by separate turbines at 975 r. p. m. Either one has sufficient capacity to excite the fields of both generators. The exciter turbines are connected by a short length of pipe to the casings of the large wheels and discharge into their respective tail races.

The low potential switchboard is of the usual type, consisting of one exciter panel and two generator panels with the necessary instruments and switches to permit the single or multiple operation of both exciters and generator fields and the operation of each gen

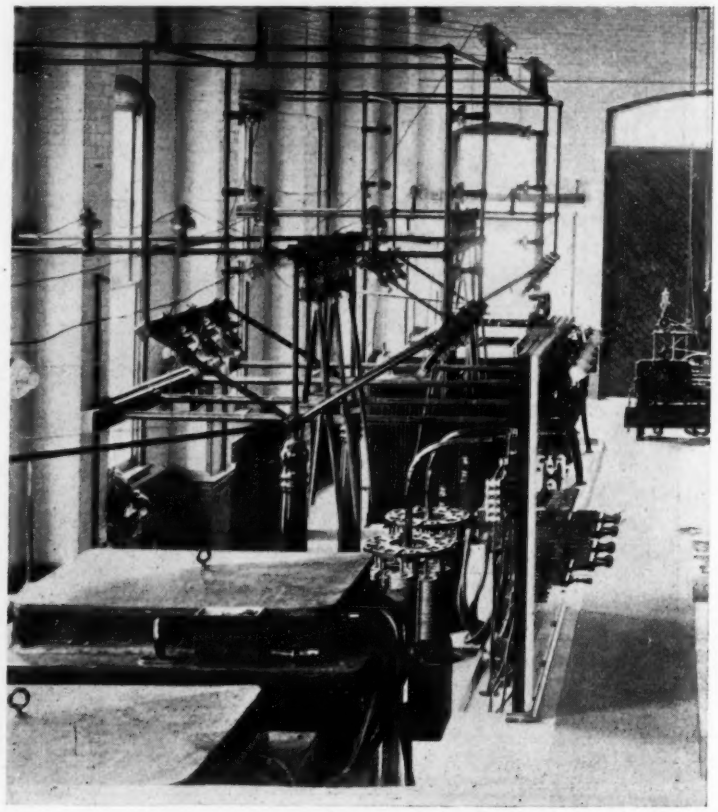


FIG. 3.—HIGH-TENSION SWITCHES.

erator with either or both sets of three oil insulated, 500 to 22,000-volt transformers; or of the two machines in multiple on either or both sets. The leads from the high-tension side of the transformers run directly up overhead to the high potential switches, known as the Masson type of switch, and consisting of a framework of gas pipe to which pins and glass insulators are secured. The handles of the switches are of wood enclosing a fuse which connects the copper terminal at the extreme upper end of the handle to the contact jaw secured to the wood near the lower end. The opposite contact clip is secured to the bottom of a pin screwed into a glass insulator fastened to the iron framework. Thus all the high potential wires are run on glass insulators only, the jaws on insulator and handle serving to make and break the circuit. The switches are so arranged that either or both sets of transformers may be connected to either side of the double three-phase transmission line, or both sets may be operated in multiple on either or both circuits.

From the high-tension switches and lightning arresters, the two circuits are run through openings high up in the power house wall, under the gable, directly to the first pole of the transmission line. The

poles are of redwood, 11 ins. x 11 ins. at the butt, 7-ins. x 7 ins. at the top and 30 ft. long, carrying two cross arms and two brackets for telephone wires. The lower cross arm carries four No. 4 B. & S. gauge copper wire on oil treated eucalyptus pins and Locke insulators, while the upper arm carries the third wires of each circuit. Transpositions occur at intervals of 144 poles. The line from power house to sub-station traverses rather a rough country, and for the greater part of the 33 miles the poles are placed 130 ft. apart. The full load line loss at 22,000 volts with the two circuits in parallel is slightly in excess of 10 per cent.

In view of the fact that the Consolidated California & Virginia shaft demands the maximum amount of delivered power, the sub-station at Virginia City is situated closed to its works. Here current is delivered to two sets of three transformers, and distributed to the switchboards at the various mines at 2250 volts, three-phase. The building is 50 ft. by 24 ft., of corrugated, galvanized iron, containing a bedroom, storeroom and office, beside the room necessary for operating the station. The high-tension switches are of the same type and arranged in the same way as those at the power station. The low potential, or distributing switchboard, is of white marble in six panels, two of which are receiving, and four feeder panels. Instruments and switches are arranged in such a manner as to maintain the maximum flexibility of operation, which is a feature at the power station.

To meet the conditions of measurement of delivered power imposed by the contract, as above stated, a special form of recording wattmeter was designed. It consists essentially of two indicating wattmeters, the moving parts being mounted on the same shaft, which is provided with an arm with platinum point. A disk of sensitized paper, already spaced and ruled, is rotated by clockwork between the platinum point and a metal plate, the continuous record being obtained by means of an electrostatic spark passing through the paper. In order to produce a record that will show definitely the highest two-minute load reading, which is the only part of the record required in determining the power to be paid for, the paper disk is made fourteen inches in diameter and rotates once an hour for twelve hours, the highest peak for a period of two minutes being readily determined.

The 2250-volt distribution system from the sub-station at Virginia City is similar in construction to the transmission line. It consists of four circuits of insulated copper wire, the longest of which is two miles. The loss between any of the mines and the sub-station in no case exceeds 4 per cent.

The application of electric power at the mines is being made as rapidly as the necessary apparatus can be obtained. Electric hoists will be installed, using the balanced tail-rope system driven by direct geared 200-hp motors. Air compressors are belt driven, and provided with an automatic by-pass valve on the cylinders, controlled by the air pressure of the receivers, and so arranged that the by-pass valves are either full open or closed, the speed of opening or closing being adjustable.

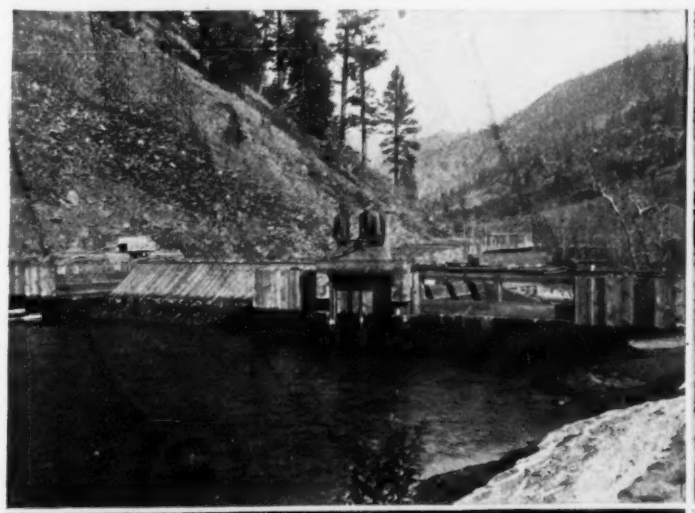


FIG. 4.—HEAD WORKS AT FLUME ENTRANCE.

FIG. 5.—SIDE-HILL CONSTRUCTION OF FLUME.

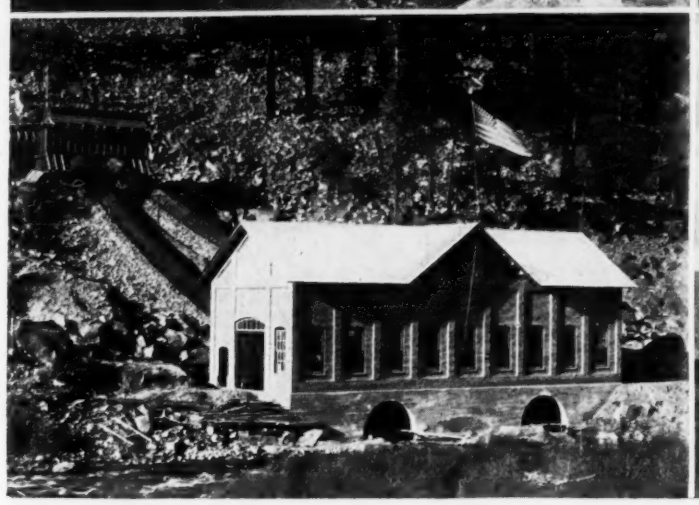


FIG. 6.—POWER HOUSE.

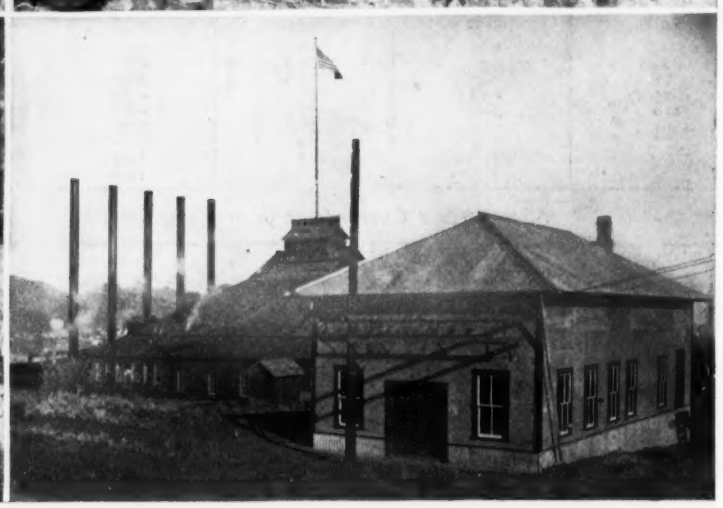


FIG. 7.—SUB-STATION AT VIRGINIA CITY.

ELECTRIC POWER ON THE COMSTOCK LODE.

Current for the underground stations is carried down the vertical shaft of the Consolidated California & Virginia to the 1750-ft. level by means of a three-conductor lead-encased cable protected by a steel wire armor.

A 100-ton mill with two sets of grinders and three sets of concentrators is equipped with six induction motors, one for each set of grinders, concentrators and the rock breaker. Ore from the Gould & Curry mine is brought to the mill by a small direct current haulage equipment, to which current is furnished by a 220-volt direct current generator belt driven from an induction motor.

Plans are being prepared by Mr. Leon M. Hall, engineer for the Comstock Pumping Association, for an extensive electric pumping equipment to take the place of the jet pumps now in use.

Construction work on the Truckee River General Electric Company's plant was commenced on Jan. 2, 1900, and current delivered in

Virginia City for the first time on Sept. 29, regular service being started on Oct. 20.

The Engineering Offices, of San Francisco, had in charge the entire engineering work connected with the design and installation of the plant, and the Pacific Construction Company were contractors for the erection of dam, flume, pipe lines and building.

The Induction Motor—IV.

By B. A. Behrend.

THE LEAKAGE FACTOR.

THERE are two questions of the most vital interest which intrude themselves at every step upon the designer. The first is, How does the maximum output a polyphase motor is capable of yielding, depend upon the air-gap? In other words, if I increase the air-gap, does this to any great extent decrease the output? And does a decreased air-gap increase the output of the motor? The second question is this: If a motor is wound for four poles, and we want to wind it for eight poles, provided the frequency and the induction in the air-gap remain the same, does the output decrease in the ratio of $4 \div 8$, or, what relation exists between the maximum output of the motor and the number of poles? I shall now proceed to answer these questions.

THE INFLUENCE OF THE AIR-GAP UPON THE LEAKAGE FACTOR.

In order to determine the interdependence between the magnetic reluctance of the main field and the leakage factor, the following experiment was made: The magnetic field—the stator—of a three-phase current motor was provided with two armatures, the diameters of which were so chosen as to create an air-gap of 0.5 mm, and one of 1.5 mm. The magnetizing currents were then measured as well as the short-circuit currents. The following tables contain the results of the experiment:

Magnetizing Currents at 50 ~

$\triangle = 0.5$ *m. m.*		$\triangle = 1.5$ *m. m.*	
Volts.	Amperes.	Volts.	Amperes.
37	1	16.5	1.05
55.5	1.5	34.7	2.25
78	2.1	55.5	3.40
95.5	2.55	75	4.70
116	3.20	77	4.80
		77.5	5.00
		99	6.40
		113	7.30
		114.5	7.40

Short-circuit Currents at 50 ~

$\triangle = 0.5$ *m. m.*		$\triangle = 1.5$ *m. m.*	
Volts.	Amperes.	Volts.	Amperes.
17.4	5.1	16.2	5.4
36	12.5	36	14.85
36.5	12.7	37.6	14
58	20.3	55.5	22.5
77	29.5	79	33.5

Resistance of primary: Each phase, 0.05 ohm.
Resistance of secondary: Each phase, 0.50 ohm.

The data of these tables are graphically represented in Fig. 16 and Fig. 17. The most remarkable fact illustrated by these curves is that the short-circuit current remained almost unaltered for the two different air-gaps. We interpolate from these curves for 110 volts in each phase the respective short-circuit and magnetizing currents, and thus get the following values:

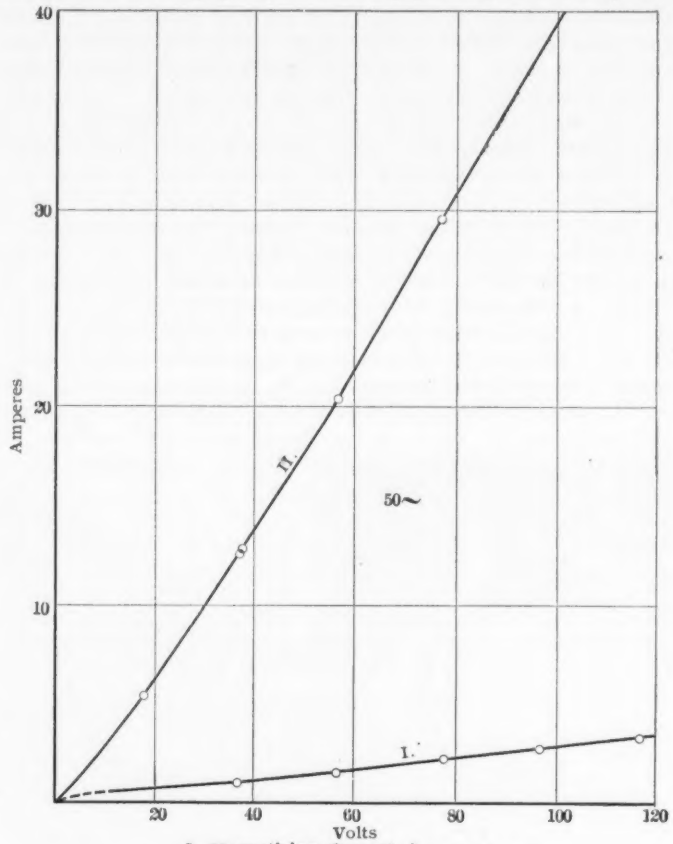
$\triangle = 0.5$ *m. m.*
Magnetizing current: 3 amperes.
Short-circuit current: 42 amperes.
Watts consumed: 8550 watts.

$\triangle = 1.5$ *m. m.*
Magnetizing current: 7 amperes.
Short-circuit current: 47.5 amperes.
Watts consumed: 9100 watts.

With these data the semi-circles in Fig. 18 are drawn. We thus find for the leakage factor the following values:

$\triangle = 0.5$ *m. m.* $\sigma = 0.058$
$\triangle = 1.5$ *m. m.* $\sigma = 0.128$

The leakage factor is, according to these experiments, directly proportional to the magnetizing current, or, in other words, to the magnetic reluctance of the main field. In our case the reluctance of the iron path is not negligible, as the air-gap of 0.5 mm is very small,

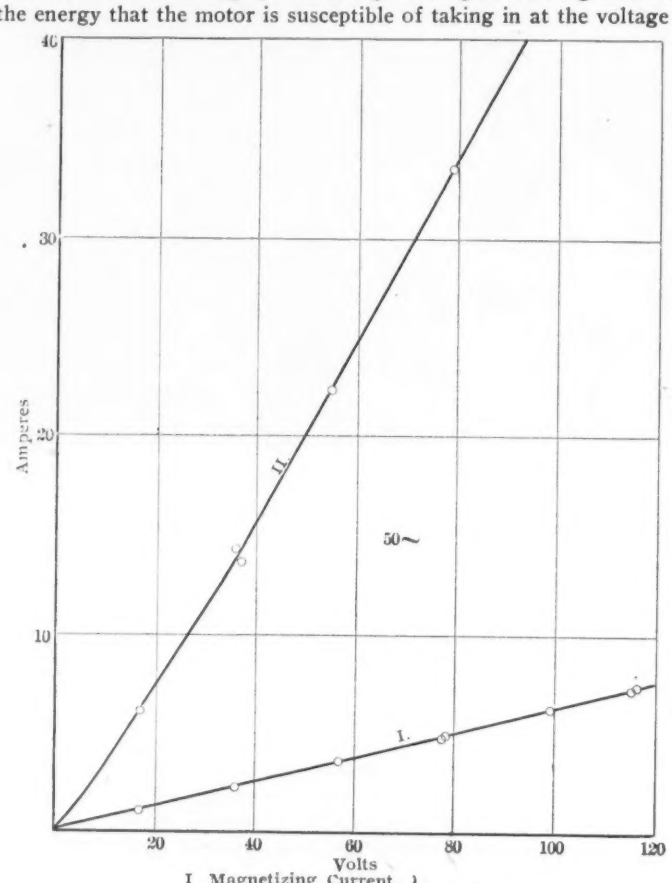


I. Magnetizing Current. } $\triangle$ = 0.5 m.m.
II. Short-circuit Current. }

FIG. 16.

otherwise the leakage factor would have been proportional to the air-gap.

Now, this result is highly interesting. As a glance at Fig. 18 shows, the energy that the motor is susceptible of taking in at the voltage of



I Magnetizing Current. } $\triangle$ = 1.5 m.m.
II. Short-circuit Current. }

FIG. 17.

110, is the same whether the air-gap is small or large. Hence, ***the overload that a motor is able to stand is independent of the air-gap.***

The air-gap influences merely the strength of the magnetizing current, but not the output.

The curves of the short-circuit currents in Figs. 16 and 17 are almost straight lines owing to the open slots in the field of our motor.

There remains to be answered the second question, How is the leakage factor dependent upon the pitch of the poles?

THE INFLUENCE OF THE POLE-PITCH UPON THE LEAKAGE FACTOR.

Before entering upon the experiments made to clear up this point, I shall attempt to show deductively how the leakage factor may be expected to vary with the pole-pitch.

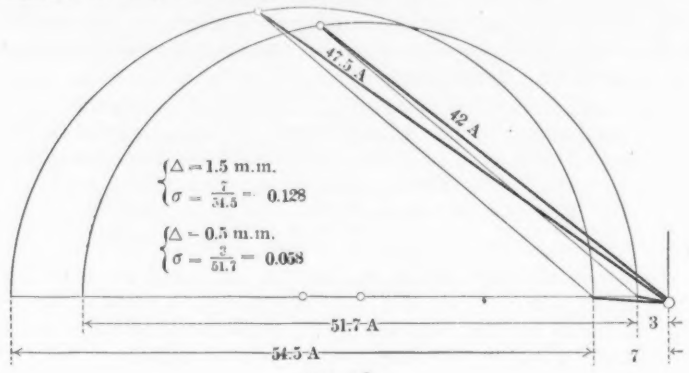


FIG. 18.

Fig. 19 gives a view of the slots in a polyphase motor. The broken lines mark the leakage flux threading each slot. Now, let us assume that we have a motor with 48 slots in the field, which we want to wind as a two-pole, four-pole, or eight-pole motor, the armature being provided with a squirrel-cage winding, thus being suitable for any number of poles.

If the number of ampere-conductors per slot remains the same for any number of poles, the leakage flux per slot also remains constant.

The total number of ampere-turns spread over the circumference of the field is then constant whether the motor has two, four, or eight poles.

But the number of ampere-turns per pole is inversely proportional to the number of poles; hence, the induction produced by these ampere-turns in the air-gap is also inversely proportional to the number

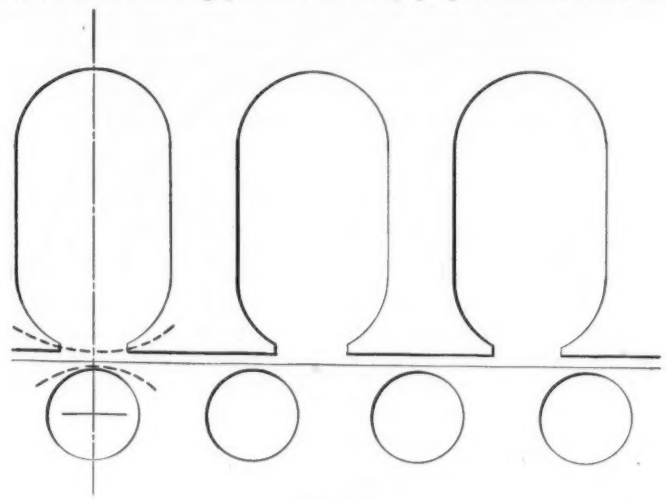


FIG. 19.

of poles. In other words, the magnetic field per pole, being proportional to the product of the induction in the air-gap into the pole-pitch, varies inversely with the square of the pole-pitch.

The leakage field, as we have seen, is constant for each slot. Hence, the total amount of leakage—the sum of all the leakage fields pertaining to each slot—is also constant. The number of leakage lines per pole is proportional to the number of slots per pole.

The ratio of leakage field ÷ main field is therefore inversely proportional to the pole-pitch for the same number of ampere-turns per slot.

This result is verified by the following series of tests:

A.—Three-phase current motor for 36 horse-power, 380 volts between the lines, six poles, 42 ∼.

Air-gap $\triangle = 0.62$ *m. m.*
Pole-pitch $t = 30.5$ *cm.*

Volts between the lines.	Amperes, field.	Amperes, armature.	Frequency.
81	36	95	42
120	74	180	
150	106	260	
170	135	320	41
383	8.5	0	43.2

If we draw the short-circuit curve, we can interpolate for 380 volts the short-circuit current of 380 amperes. We thus get for the leakage factor the value

$$\sigma_1 = \frac{8.5}{380} = 0.0224$$

B.—The same magnetic frame was wound for 24 horse-power, 190 volts between the lines, ten poles, 50 ∼.

Air-gap $\triangle = 1.1$ *m. m.*
Pole-pitch $t = 18.3$ *cm.*

Volts between the lines.	Amperes, field.	Frequency.
20	20	51
25	31.5	
33	50.5	
43.5	75	51
66	139	
83	185	
95	220	

Magnetizing current: 31.2 amperes at 190 volts. The short-circuit current at 190 volts amounts to 470 amperes. Hence,

$$\sigma_{11} = \frac{31.2}{470} = 0.0664$$

The following table shows the results of the tests in a perspicuous form:

Air-gap *cm.*	Pole-pitch *cm.*	σ
0.062	30.5	0.0224
0.11	18.3	0.0664

For equal air-gaps we have

$$\sigma_1 = 0.0224 \cdot \frac{0.11}{0.062} = 0.0396$$

$$\sigma_{11} = 0.0664$$

Hence,

$$\frac{\sigma_{11}}{\sigma_1} = \frac{0.0664}{0.0396} = 1.68,$$

or, in other words,

$$\frac{\sigma_{11}}{\sigma_1} = \frac{t_1}{t_{11}}.$$

The leakage factor is inversely proportional to the pole-pitch, or directly proportional to the number of poles.

By the above experiments it has been demonstrated that the leakage factor is directly proportional to the air-gap, and inversely proportional to the pole-pitch. We may, therefore, write the formula for the leakage factor,

$$(12) \ldots\ldots\ldots\ldots \sigma = c \cdot \frac{\triangle}{t},$$

in which equation c is a factor dependent upon the shape and size of the slots, and upon a great many other conditions of which we are still profoundly ignorant. For practical purposes, however, c can be determined with satisfactory accuracy, though it will still be left to the designer to estimate the value of c between certain limits. For slots, as shown in Fig. 19, c varies between 10 and 15.

WINDING THE SAME MOTOR FOR DIFFERENT SPEEDS.

Formula (12) permits us to determine the change in the output, power factor, and so forth, of a motor wound for a different number of poles, for instance, for eight, four, or two poles. If the field has 48 or 72 slots, it can easily be wound so as to satisfy this demand. We will assume the induction in the air-gap, or, which is the same, in the teeth, to remain constant for all three cases. We will further assume that the motors are to be wound for the same voltage. Then it is clear, according to equation (5), that the total number of active conductors must be proportional to the number of poles; in other words, if the eight-pole motor has, for instance, 720 conductors, or ten conductors in each of 72 slots, then the four-pole motor must have 360, and the two-pole motor 180, in order to get the same induction in the air-gap. To calculate the relative value of the magnetizing cur-

rent we need only know the number of active conductors n per pole, see equation (6). We have for n in the eight-pole motor $\frac{720}{8} = 90$; in the four-pole motor $\frac{360}{4} = 90$; and in the two-pole motor $\frac{180}{2} = 90$. Hence, as B and n are the same in each of the three cases, it follows that the magnetizing current also remains the same. As the shape and size of the slots are the same in all three cases, the factor in equation (12) for the leakage coefficient also remains the same. Hence, as the leakage factor is proportional to the quotient of the air-gap divided by the pole-pitch, we find the short-circuit current to be inversely proportional to the number of poles. This is graphically

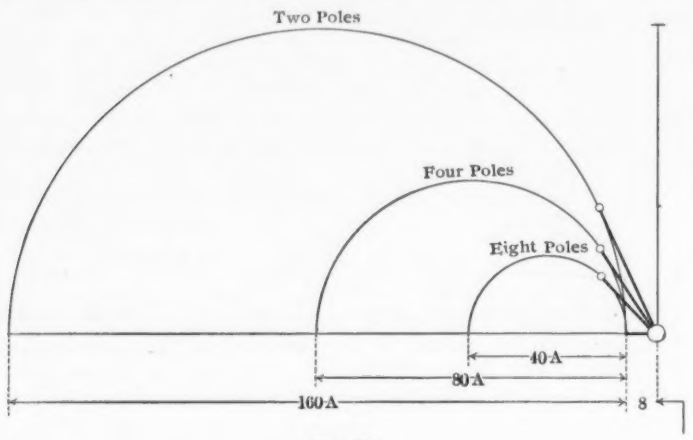


FIG. 20.

represented in Fig. 20. A glance at the diagram teaches us that the maximum energy that can be impressed upon the motor, and, therefore, also very nearly the output, vary in proportion to the pole-pitch. According to the diagram we find the leakage factor for the two-pole motor equal to $\frac{8}{160} = 0.05$; for the four-pole motor equal to $\frac{8}{80} = 0.10$; and for the eight-pole motor equal to $\frac{8}{40} = 0.20$. The power factor in each case can now be calculated with the help of formula (3). This is done in the following table:

Number of Poles.	Leakage Factor.	Maximum Power Factor.	Relative Output.	R. P. M.
2	0.05	0.91	80	3000
4	0.10	0.835	40	1500
8	0.20	0.715	20	750

The output is therefore proportional to the number of r. p. m.

It may not be amiss here to remark that if the motor is ordinarily wound for four poles, the induction in the iron above the slots may for the same frame become too high in the two-pole motor, thus increasing the magnetizing current, and, possibly, creating undue heating.

DRAWBACKS OF A HIGH FREQUENCY.

If the circumferential speed of the armature is limited, and this is generally the case, then the pole-pitch is also limited for a given number of r. p. m. The air-gap cannot indefinitely be diminished, hence a high frequency necessitates a large leakage factor according to formula (12). We labor here under the same difficulties that we have met with in the design of alternators for high frequencies.[5] It is doubtless possible to build motors for frequencies between 60 and 100, but the higher the frequency the lower will be the power factor, the larger will be the lagging currents. It has also to be borne in mind that motors for high frequencies, if they are to be as good as those low frequencies, must be made not inconsiderably larger.

Allowing again the induction in the air-gap to be the same for different frequencies, which is a more or less challengeable proposition, it follows from formula (5) that the total number of active conductors around the circumference of the field must also be the same, for the pole-pitch is inversely proportional to the frequency, hence the product of the frequency into the number of lines of induction per pole remains the same if the induction in the air-gap is the same.

The magnetizing current, however, being proportional to the quotient of the induction B divided by the number of active conductors per pole, is thus inversely proportional to the frequency. The leakage factor is, according to formula (12) directly proportional to the pole-pitch, or inversely proportional to the frequency—because the pole-pitch is, in the case under consideration, inversely proportional to the frequency—hence it follows that, as the magnetizing current has been shown to be proportional to the frequency, the diameter of the semi-circle remains constant for all frequencies.

Fig. 21 shows the clock diagram for the same motor, but for different frequencies. The maximum energy that the motor is capable of taking in, and, therefore, also the maximum output, is the same for 100 ~, 50 ~, or 25 ~. But the maximum power factor is considerably smaller for the high frequencies, as a glance at the diagram shows. The following table shows the leakage factor and the power factor in relation to the frequency:

Frequency.	Leakage Factor.	Maximum Power Factor.
25	0.05	0.91
50	0.10	0.83
100	0.20	0.715

I wish to call attention to the fact that the motor for the higher frequencies is here represented less unfavorably as it really is, because the induction in the air-gap has to be reduced if the motor is to be wound for a higher frequency. The immense lagging currents invariably bound up with the higher frequency, are very clearly shown in the diagram.

It is to be remembered that the current in the armature is dependent upon the leakage factor, since the transformation factor v_2 forms part of the leakage factor, see Fig. 6. The transformation factors v_1 and v_2 are connected with σ through equation (2),

$$\sigma = \frac{1}{v_1 v_2} - 1$$

Hence it follows, as $i_2 = \overline{AD} \cdot \frac{n_1}{n_2} \cdot \frac{1}{v_2}$, see Fig. 6, that the current in the armature is larger for the motor running at a high frequency than for that running at only 25 ~. In our case, setting $v_1 = v_2$, we get for v at 25 ~ 0.978, and at 100 ~ 0.912, therefore the current in the armature of the motor for 100 ~ is, for the same $\overline{AD}$, 1.07 times larger than for 25 ~. This corresponds to a greater armature loss

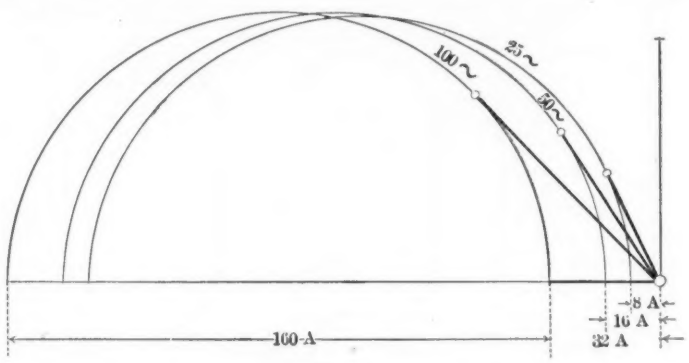


FIG. 21.

of about 14 per cent. But as the primary current is also larger for 100 ~ than for 25 ~, the armature loss is still greater than here calculated. Thus to the drawback of large lagging currents, has to be added the further drawback of considerably larger losses.

The foregoing experiments and considerations are, within my knowledge, the first attempt to deal in a rational, systematic manner with the conditions underlying the leakage in polyphase motors. I am far from claiming for this treatment completeness or conclusiveness; on the contrary, I deem it a necessity to revise it by the light of forthcoming experience. I am tolerably confident that the main propositions will be proved true, while minor points may need some qualification.

Considering the immense complexity of the phenomena in polyphase motors, the greater or less arbitrariness which hangs about most of our assumptions which have to be made in order to be able to calculate at all, I cannot forbear from wondering that so approximate a solution can be attained at all. It may be that there are errors inherent in our fundamental assumptions which all so counteract one another as to cause the result of calculation to deviate but little from

[5] See the author's papers in the ELECTRICAL WORLD AND ENGINEER, Jan. 20, 27 and Feb. 3, 1900.

experiment and observation. This view will commend itself to those who are familiar with any branch of physiology, for instance, physiological optics; here we have the testimony of Helmholtz that the eye, having "every possible defect that can be found in an optical instrument," yet gives us a fairly accurate image of the outer world because these various defects balance one another almost completely.

The above remarks will be distasteful to those who have accustomed themselves to look upon only one side of a question, and try to shut their eyes to the inevitable uncertainties that beset us in all intellectual problems. I was once taken to task by a critic for having adduced experimental evidence qualifying a theory, and narrowing the limits of its application, and I was told that these experiments invalidated my argument, while my intention—to lay stress upon the incompleteness and the shortcomings of the theory—was obviously not even thought of by my critic. Lawyers may have to hide the weak sides and spots of their arguments, but men of science are bound to point them out and expose them.

The formulæ and rules of the preceding articles will now be turned to account in the following part by applying them to the calculation of a motor.

The Paderno, Italy, Transmission Plant.

FEW of the many papers presented at the recent Paris International Electrical Congress dealt with electrical engineering from its construction side, but one of this character was of first-class importance—a paper by Signor Guido Semenza on the practical operation of the large Italian plant for the generation of electrical energy at Paderno and its transmission to Milan and adjoining districts. The paper was read from manuscript, but we are enabled to present some of its main features through the courtesy of the author, who is the electrical engineer of the Societa Generale Italiana di Eletricita Sistema Edison, of Milan, Italy, the company which owns and operates the Paderno plant.

The generating station is situated at Paderno d'Adda, some 25 miles distant from Milan, where seven units of 2160 horse-power each are installed, consisting of seven turbines made by Messrs. Riva, Moneret & Company, of Milan, driving seven alternators made by Messrs. Brown, Boveri & Company, of Baden, Switzerland. Three-phase currents are generated at a tension of from 12,000 to 15,000 volts and with a frequency of 42 cycles. This energy is brought down to Milan, where the tension is reduced to 3700 volts. About 100 substations reduce it again to 160 volts for light and power purposes. In the centre of the town rotary converters are installed, converting the three-phase currents into direct current for light and traction, which latter use absorbs about 2000 horse-power.

Experience and accurate observations have demonstrated that the fears entertained by some engineers and manufacturers as to the possibility of obtaining perfect insulation in alternators developing current at 15,000 volts are unfounded. Tubes of micanite ¼ in. thick have been found sufficient to insulate the windings from the surrounding iron even at a pressure of 21,000 volts. Only two accidents have thus far occurred, consisting in each case of the formation of an arc between the three bobbins of the three-phase circuit, situated at the lowest part of the machines, the space between the nearest points of the bobbins being 2 ins. This happening could not be ascribed to atmospheric discharges, as in both cases the weather was fine and calm. As accidents of the same nature have occurred to machines of lower potential, a condemnation of a voltage of 15,000 from this cause is consequently not justified.

The placing in parallel and the simultaneous working of the alternators have never given rise to any trouble whatever. The coupling can be effected with no load and with the greatest ease, which implies an extremely satisfactory working of the turbine governors. The distribution of the load is effected by means of small motors, which act on the governors and which are worked from the switchboard. It is also interesting to note that the alternators at Paderno, driven by turbines, work with perfect regularity when coupled with those at the Milan station, which are driven by steam engines, although situated 25 miles apart.

The efficiency trial of these machines has been made by measuring the losses separately at full load, and they have been found to aggregate about 5 per cent, subdivided as follows: Mechanical losses, 1.25 per cent; copper losses, 1.15 per cent; iron losses, 2.50 per cent; excitation, 0.10 per cent. The efficiency was found to be 4 per cent, with a power factor of .8, the drop at full load being about 6 per cent for $cos\ \phi = 1$ and about 15.5 per cent for $cos\ \phi = 0.8$.

The exciters are on the generator shafts, and while the regulation is rather difficult at small load, it is satisfactory near the normal load.

Special care has been taken in the construction and arrangement of the switchboard, which covers an area of about 1000 square feet. Its most important elements are the switch and the fusible cut-outs. The quick-break switch in oil has proved to be very successful, as it allows the interruption of a current of 100 amperes at 15,000 volts with no other effect than a very small spark in the oil. On the contrary, the fusible cut-outs have not given satisfaction, for, besides not being easily calibrated, the metallic vapors which arise at fusion frequently cause an arc from one connection to another, resulting in serious short circuits.

The main line is formed of 18 copper wires, 3/8 in. diameter, carried by two rows of poles 79 ft. apart. Each row carries 9 wires, so

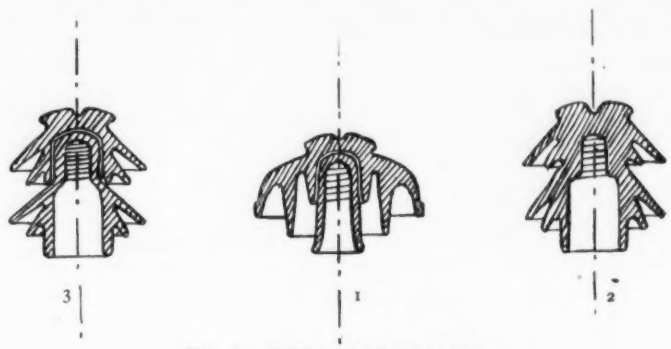


FIG. I.—TYPES OF INSULATORS.

arranged as to occupy a series of equilateral triangles. By this arrangement a workman may work on half the line without danger, while the other half is in service.

The poles, which are of iron, have led to no trouble, as was generally feared, when proper and suitable insulators are employed. Several tests have been made on different types of insulators by means of a transformer giving up to 50,000 volts. Under such test the German types were discarded, and the very open and largest American type selected. Three varieties of this type are used on the line, designed by Engineer Semenza and manufactured by Messrs. Richard-Ginori, of Milan. The first consists of two parts separately constructed; the second represents all that can be desired with reference to shape to prevent disruptive discharges, and the third type is a combination of the two former. One thousand seven hundred and fifty of the first type are employed, and none were rejected on test. Of the second type 3500 are employed, and but 6 were perforated on test.

A complete series of measurements has been made to determine the working condition of the line. Measurements of this nature are not easily made, considering the quantity of energy passing and the high working tension. A portion of these measures refer to the determination of the load and to the resulting power factor. These were made on the bus-bars of the transforming station in Milan at the outlet of the cables forming the network system at 3700 volts, with a distribution of 3930 kilowatts, subdivided as follows: 827 kilowatts in the east part of the town, almost totally absorbed by synchronous motors, with a power factor of .76; 1150 kilowatts in the west part of the town, under the same condition of load the power factor was 0.65; 1345 kilowatts absorbed by generating motors for traction and lighting purposes using direct current; the synchronous overexcited motors had a leading current corresponding to $cos\ \phi = 0.83$; 608 kilowatts for electro-chemical industries, with a power factor of 0.70.

It is here well to note that manufacturers quote $cos\ \phi = 0.85$ and $cos\ \phi = 0.90$ as factors guaranteed, though in practice it is found that motors working on full load are very limited. It must be noted also that in Milan the distribution is very much subdivided, the small motors being greatly preponderant. Besides, one must give due weight to a possible influence of transformers reducing the tension from 3700 to 160 volts. With the values above named it is found that the total current lags an angle corresponding to $cos\ \phi = 0.91$, and that the synchronous overexcited motors exercise a very important action. The influence of the principal transformers on the displacement of phase has been calculated at from 0.91 to 0.89.

In these conditions we have: Voltage at the generating station, 14,300 volts; voltage at the receiving station, 12,500 volts; current, 80 amperes.

As the resistance of each wire was at that moment 9.6 ohms it follows that: The voltage drop = 12.6 per cent; energy loss = 10.4 per cent.

The drop in voltage is then 1.35 times greater than the ohmic loss. With *cos* $\phi = 1$ we would have: Voltage at the generating station, 13,650 volts; voltage at the receiving station, 12,500 volts; current, 64 amperes; voltage drop, 8.4 per cent; energy loss, 7.9 per cent.

The angle of lag due to the line is then 43 degs. This angle measured by the method of short circuiting the line was found to be 40 degs.

The capacity current absorbed by the line presents very marked variations depending upon the form of the curve. In normal working for 12,000 volts (42 cycles), 1.03 amperes were found. To divide this current into the two component elements, namely, the capacity current and the leakage current, Mr. Semenza adopted an ingenious method, which consists in inserting between two wires of the line a lamp resistance and measuring, with the aid of three ammeters, the current absorbed by the line, that of the lamps and the resulting

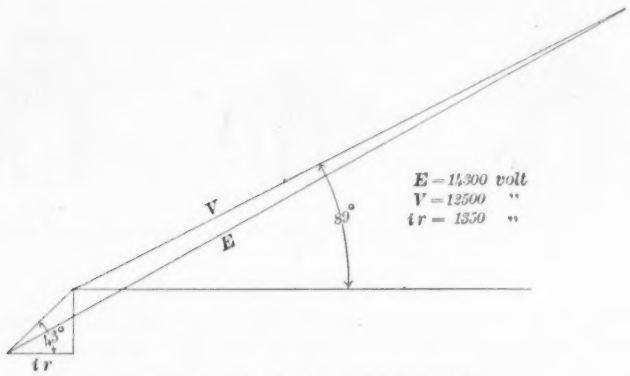


FIG. 2.—DIAGRAM OF COMPONENTS.

total, which form a triangle in graphical representation. Separating the current absorbed by the line into two components, one parallel to the e. m. f. (determined by the current in the lamp) and the other in quadrature with it, he found 0.24 ampere to be the value of the leakage current, and 1.008 amperes the value of the capacity current.

The greatest care must be taken to protect the lines from atmospheric discharges, and Mr. Semenza furnishes some interesting information on this point. At the extremity of the lines a number of Wurts lightning arresters are installed and along the line groups of Siemens lightning arresters. Heavy storms were frequent during the year 1899 and also in the present year. The interruptions of service due to this cause have been four in number, and but two of these have been ascribed to faulty working of the lightning arresters. Seldom more than four or five discharges occur during a storm. Whether this is due to local conditions, to the protecting action of the iron poles or to the type of the lightning arresters, the slowly and continuously discharging of which prevent the accumulation of static charges, is yet to be ascertained. The Siemens lightning arresters have acted properly several times, although their discharges cause a considerable lowering of tension, which may possibly provoke the falling out of step of synchronous motors.

Mr. Semenza thinks that in general it is almost impossible to foresee or prevent accidents which occur on lines of very high potential on account of their instantaneousness, and earth indicators have seldom been of any real service.

Generally the motors that are in circuit at the instant when a short circuit is formed stop instantaneously and become so many short circuits themselves. In such contingencies the only possible thing is to immediately shut down the excitation.

With reference to disturbances in telephonic lines, so common in installations like the Paderno-Milan installation, caused by lines at high potential, Mr. Semenza ascribes them to electrostatic induction. After careful observations and tests he found, in fact, that the line assumed a difference of potential to the earth of about 250 volts through electrostatic induction, and that every trouble ceased by insulating very carefully all the telephone circuits.

Mr. Semenza closed his interesting paper by a reiteration of his opinion as to the perfect practicability of high potentials, which opinion was shared at the congress by M. Hillairet, president of the section before which the paper was read, who stated, moreover, that the Paderno installation is a model installation in every respect.

Elements of Illumination—XV.

By Dr. Louis Bell.

INCANDESCENT ILLUMINANTS.

THE general class of illuminants operative by the incandescence of a fixed solid body would include in principle both arc and and incandescent electric lamps, as well as those in which the radiant substance is heated by ordinary means. In this particular place, however, it seems appropriate to discuss the latter forms only, leaving the electric lights for a separate paper.

Incandescent radiants brought to the necessary high temperature by a non-luminous flame have their origin in the so-called "Drummond" or "lime" light, which has been used for many years as the chief illuminant in projection, scenic illumination on the stage and such like purposes, and which has only recently been extensively replaced by the electric arc. The lime light consists of a short pencil of lime against which is directed the colorless and intensely hot flame from a blast lamp fed with pure oxygen and hydrogen, or more commonly with oxygen and illuminating gas.

The general arrangement of the oxy-hydrogen burner is shown in Fig. 1. Here *A* and *B* are the supply pipes for the oxygen and hydrogen, fitted with stop-cocks. These unite in a common jet in the burner *E*, which is usually inclined so as to bring the burner where it will not cast a shadow. Sometimes the two gases are mixed in

FIG. 1.—OXY-HYDROGEN BURNER.

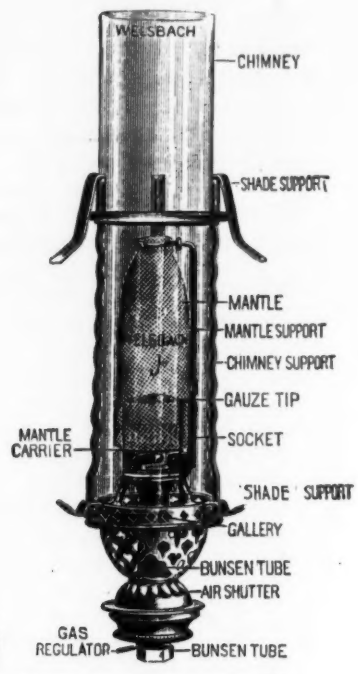


FIG. 2.—STANDARD WELSBACH BURNER.

the burner tube *C*, and sometimes the hydrogen is delivered through an annular orifice about a central tube which supplies the oxygen. The pencil of lime is carried on a holder *D*, and the whole burner is often carried on an adjustable stand *E*, so that it can be raised, lowered or turned as occasion demands. The mixed gases unite in a colorless, slender flame of enormously high temperature, and when this impinges on the lime the latter rises in a small circular spot to the most brilliant incandescence, giving an intense nearly white light of, generally, 200 to 400 candle-power.

The light, however, falls off in brilliancy very rapidly, particularly when the initial incandescence is very intense, losing something like two-thirds of its candle-power in an hour, so that it is the custom for the operator to turn the pencil from time to time to expose new portions to the oxy-hydrogen jet. At the highest temperatures the calcium oxide is somewhat volatile and the surface seems to change and lose its radiative power. Sometimes pencils of zirconium oxide are used instead of lime, and this substance has proved more permanently brilliant and does not seem to volatilize. When properly manipulated, the calcium light is beautifully steady and brilliant, and being very portable, is well adapted for temporary use.

From time to time attempts were made to produce a generally useful incandescent lamp in which the oxy-hydrogen jet should be

replaced by a Bunsen burner requiring only illuminating gas and air. Platinum gauze and other substances were tried as the incandescing materials, but the experiments came to nothing practically until the mantle burner of Auer von Welsbach appeared. This is generally known in this country as the Welsbach light, but on the Continent as the Auer light. In this burner the material brought to incandescence is a mantle, formed like a little conical bag of thin fabric thoroughly impregnated with the proper chemicals and then ignited, leaving a coarse gauze formed of the active material.

This material has been kept more or less secret, and has been varied from time to time as the burner has gradually been evolved into its present state, but is well known to consist essentially of the oxides of the so-called "metals of the rare earths," chiefly thorium and yttrium. These rare earths zirconia, thoria, glucina, yttria and a half-dozen others still less well known, form a very curious group of chemical substances. They are whitish or yellowish very refractory materials occurring as components of certain rare minerals, and most of them give a magnificent incandescence when highly heated. The hue of this incandescence differs slightly for the different earths and they are very nearly non-volatile except at enormous temperatures. One, erbia, has the extraordinary property of giving a spectrum of bright bands when highly heated instead of the continuous spectrum usual to incandescent solids, a property which it shares with a few of its curious associates.

The mantle burners of the Welsbach type are formed of various blends of the more accessible of these rare earths, and when brought to incandescence by the flame of a Bunsen burner within the mantle, give a most brilliant light with a very small expenditure of gas. As first manufactured the mantles were very fragile, breaking on the smallest provocation, but they have gradually been increased in strength until those now made generally hold together for many hundred hours, and usually should be discarded for inefficiency long before they break. This statement refers to mantles burned indoors and not subjected to any unusual vibration, which greatly shortens their life.

As at present manufactured the standard Welsbach burner complete is shown in Fig. 2, of which the several parts are distinctly labeled in the cut. It consists essentially of a Bunsen burner with provisions for regulating the flow of both air and gas, capped by fine wire gauze to prevent the flame striking back, and the mantle within which the Bunsen flame burns. There are suitable supports for the chimney and shades and for the mantle. The mantle carrier is permanently attached to a cap with a wire gauze top, and this cap goes into place on the burner tube with a bayonet joint so that the mantle is brought exactly to the right place, instead of having to be adjusted over a permanent cap. This is one of the most important recent improvements in this type of burner, since previously the risk of breaking in adjusting a new mantle had been very considerable.

Several makes of mantle burners are in use at the present time, but the ordinary Welsbach may be considered as a type of the best modern practice, and the data here given refer to it, and are at least as favorable as would be derived from any other form.

As in most other burners, the efficiency of the mantle burner increases somewhat with the capacity, but the general result reached in common practice with 16 candle-power (nominal) gas is 12 to 15 candle-power per cubic foot of gas, assuming the mantle to be new. In other words, at the start, the mantle burner is nearly five times as efficient as an Argand burner, about six times as efficient as an ordinary burner, and two to three times as efficient as the powerful regenerative burners. This economy is not maintained, the efficiency of the mantle falling off with use, rapidly at first, more slowly afterwards. This is due in part to actual diminution in the radiating surface of the mantle from surface disintegration and in part to real decrease in the radiant efficiency. Fig. 3 shows a set of life curves from Welsbach burners, which are self-explanatory. In about 300 hours the efficiency has fallen off nearly one-third, after which it decreases less rapidly during the remainder of the life of the mantle.

This decrease in efficiency with age is similar to that found in incandescent electric lamps, but more rapid. Nevertheless even after 300 hours the mantle is still good for 8 or 10 candle-power per cubic foot of gas, and remains far more efficient than any other class of gas burner. The working life of the mantle is stated by Dr. Fähndrich, director of gas at Vienna, to be about 350 hours, taking due account of this difference in efficiency. It is safe to say that averaging the working efficiency over this term of life the mantle burner with gas at $1 per thousand cubic feet can be operated at a cost not exceeding 0.01-cent per candle-hour for gas. This should not be raised by more than 0.0025-cent for mantle renewals per candle-hour. The upshot of the matter is that the mantle burner is by far the cheapest known illuminant except the electric arc. Obviously it uses up the oxygen and contaminates the air only in proportion to the gas used, and hence far less than other burners.

The chief objection to the mantle burner is the unpleasant greenish tinge of its light. With the early burners this was very offensive and even with the latest forms it is so noticeable that one can walk along the street and pick out the mantle burners by the greenish cast of the illumination long before reaching the window from which they are shining. The exact tinge of the light varies a little with the kind of mantle and the particular period of its life, but it is always distinctly greenish, sometimes bluish green, and in recent mantles sometimes a very curious shade of yellowish green, but never yellowish like a gas flame or an incandescent lamp, or white or bluish white like an electric arc. This color seems so far to be inseparable from the radiation derived from any feasible combination of the rare earths used to form the mantle. Sometimes in the youth of the mantle the light seems to be nearly free from this tinge, but through change in the specific nature of the radiation or dissipation of some of the components the greenish light gains prominence. Whether this difficulty can be overcome in the manufacture of the mantles, it is impossible to predict, but as has already been pointed out in these papers, it can

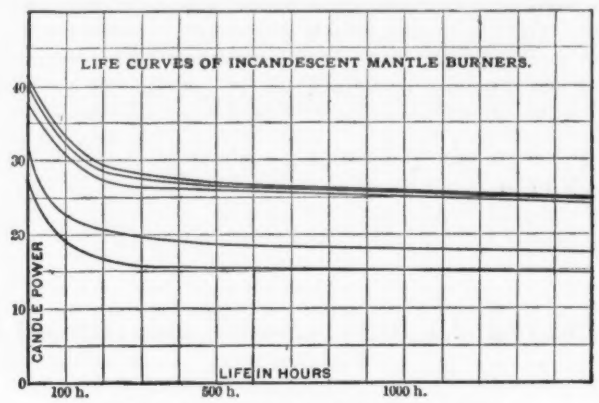


FIG. 3.—LIFE CURVES, WELSBACH MANTLE.

very easily be gotten around by proper shading, and shading is nearly always necessary in using mantle burners on account of their great intrinsic brilliancy. If the exploiters of these mantle burners had spent half the time in advising such remedial measures that they have wasted in denying the greenish hue of the light or explaining that it is quite artistic and really good for the eyes, the ordinary gas burner would now be practically driven out of use.

As regards the actual color of the light from mantle burners, it varies somewhat, as already explained, but the following table is typical of the peculiarities of the light as compared with that from an ordinary gas flame. In the table the light of the gas flame is supposed to be unity for each of the colors concerned, when the light from the mantle has the given relative values.

Color	Full Red	Yellow	Yellowish Green	B uish Green	Blue	Violet
Light from Mantle	.71	1.47	1.76	2.39	2.74	3.09
Argand taken as	1.00	1.00	1.00	1.00	1.00	1.00

As the actual luminosity of the deep red, blue and violet is comparatively small in either burner, the preponderance of green in the light from the mantle is quite marked. To correct this it is only necessary to use a shade of such color as to absorb some of the green rays. The actual percentage of light absorbed need not be at all large, provided the absorption is properly selective. The general color of the shade will generally be a light rose pink, and the result is a nearly white light, better in color than an ordinary gas flame.

The advantage of the mantle burner in steadiness and economy is so great that there is little excuse for using the more common forms of gas burner indoors, save for special decorative effects or for very small lights. The color question and the fragility of the mantle have been the chief hindrances to the general introduction of the Welsbach type, and these are certainly avertable.

Recently there have been introduced several forms of mantle burner worked with gas generated on the spot from gasolene or similar petroleum products. Sometimes these are operated as individual lamps and sometimes as small systems to which the gas-forming fluid

is piped. They give, of course, a fine, brilliant light, and at a low cost—cheaper than ordinary mantle burners worked with any except rather cheap gas. Where gasolene gas would be cheaper than gas taken from the nearest available main, such gasolene mantle burners will prove economical.

But, as a matter of fact, lamps locally generating and burning their own petroleum gas have been pretty thoroughly tried from time to time for the past twenty-five years, and have never taken a strong or permanent hold on the public. It is therefore difficult to see how mantle burners worked in similar fashion are likely to take a material hold upon the art, although in special cases they may prove very useful, when illuminating gas is not available at a reasonable price.

It must be constantly borne in mind that the lighter petroleum oils are dangerous and must be used with extreme care, and also that they are just now rapidly rising in price, owing to the increasing use of explosion engines.

In using any mantle burner, it is good economy to replace the mantle after three or four hundred hours burning, if it is in regular use to any considerable extent. Of course, in cases when a burner is not regularly used and its maximum brilliancy is not at all needed the mantle may properly be used until it shows signs of breaking. In other words, when a mantle which is needed at its full efficiency gets dim, throw it promptly away; but so long as it gives plenty of light for its situation, your consumption of gas will not be diminished by a change. The commonest trouble with mantles is blackening from deposit of soot owing to temporary derangement of the burner. This deposit can generally be burned off by slightly, not considerably, checking the air supply so as to send up a long, colorless flame which will soon get rid of the carbon, after which the full air supply should be restored. It should finally be noted that the mantle burners are particularly useful in cases of troublesome fluctuations in the gas supply, since while they may burn more or less brightly according to circumstances, they are entirely free from flickering.

The Sticking of a Relay Armature when Bridged by a Condenser.

By Walter O. Pennell.

IT has been observed, perhaps, by those interested in delicate relay work, that if the armature contacts of a closely adjusted relay be bridged by a condenser and a battery circuit arranged through the contacts, the armature will have a tendency to stick after the force holding it up is removed. This is shown in the diagram, Fig. 1, where *A* represents the contacts and *C* the condenser. The armature does not invariably stick, but will do so more or less often according to the adjustment, capacity and other conditions, which to a person not knowing the cause makes the problem of finding the trouble in intricate circuits such as occur in modern telephone practice, with this arrangement of condenser, an exceedingly difficult one.

An attempt has been made to investigate this action and ascertain the true cause of the sticking. It was found that the armature has the

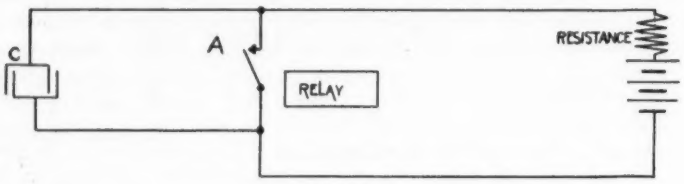


FIG. 1.

same tendency to stick whether it is pushed up to the contact mechanically, as by hand, or drawn up by energizing the relay and then opening the energizing circuit. If the condenser is removed and the armature again pushed up the sticking entirely ceases, which shows the phenomenon is not due to any residual magnetism of the core. The tendency to stick increases with the size of the condenser. If, when the armature is sticking the battery circuit be opened, or the condenser circuit be opened, or the condenser short circuited, the sticking will continue unchanged until the armature is pulled away from the contact, when it ceases. If a resistance such as *R*, Fig. 2, be placed in the condenser lead the tendency to stick is greatly diminished, and by making the resistance sufficiently large—10 to 20 ohms is usually enough—the action is entirely eliminated; on decreasing the resistance the sticking begins again. When the armature is held firmly against its back stop a millivoltmeter bridged across the contacts will give a very small reading, indicating a small resistance at the contact points. If the armature is now released and if it sticks the voltmeter needle will suddenly indicate ten or more times as much as previously, showing an increased resistance at the contacts, which is what one might expect. If the battery circuit is now broken the armature, as stated above, still sticks, but the voltmeter reading becomes zero. The attraction appears to be entirely at the contact points, and in some cases when the armature is sticking a very appreciable force is required to separate the contacts. If a piece of thin paper be placed between the points the sticking will cease, but the circuit through the armature is, of course, opened.

The explanation seems to be this. When the force holding the armature is withdrawn it tends to fall back, thereby increasing the potential at the terminals of the condenser, and so charging it. Before the armature has fallen back an appreciable distance, sufficient charge from the condenser collects at the contact points to hold the armature at rest. The charges seem to soak into the metal and being separated by an infinitesimal air space they have a strong attraction for each other, so much so that they can be removed only by pulling the contacts apart. The resistance in the condenser circuit increases the time constant, *C R*, of the condenser, by many times, retarding its charge or discharge by as many times, which, since the action must take place very quickly before the armature falls back an appreciable extent, is equivalent to decreasing the capacity in the same ratio, so that the sticking ceases or is diminished.

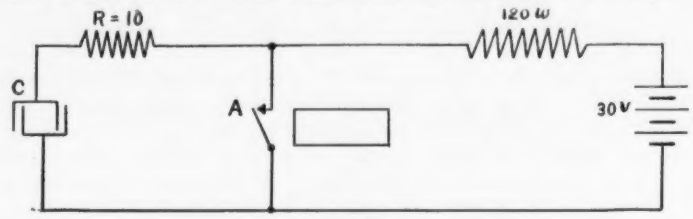


FIG. 2.

Electric Tramways vs. Motor Cars.

In these days of progress in electric traction on tramways it would appear to be a bold proposal, says the London *Mechanical World*, for any one to come forward and suggest the abandonment of schemes of this class in favor of motor cars carrying passengers along urban thoroughfares. Yet the surveyor to the metropolitan district of Chelsea has no hesitation in making a suggestion to this effect in connection with the project for the construction by the London County Council of an electric tramway from Blackfriars Bridge to Putney Bridge by way of the Victoria Embankment, Victoria Street, Buckingham Place Road and the Chelsea Embankment. The supervisor states that so long as the perverseness of the legislature threw obstacles in the way of mechanical traction on ordinary roads, so long had electric tramways an excuse, but for the last three years they have had none. Given a good smooth surface the mechanically propelled cars, in his opinion, can travel as easily as a train, and will require no overhead wires or slots in the roads, and will transport their passengers as conveniently and speedily to their destination. This is a very strong advocacy of the claims of motor omnibuses, but the question is well worthy of consideration in regard to the central or urban parts of London. We have for several years past contended that the ideal form of locomotion for thoroughfares congested with vehicular traffic would be afforded by electric omnibuses, with electric tramways in suburban districts leading to and connected with similar lines in neighboring localities which are under the control of other authorities; but as the experiments made with the omnibuses have proved commercially unsuccessul it is necessary to find a satisfactory substitute. Tramways of any kind are neither advisable nor desirable in the central parts of London, where the cars would impede rather than relieve the traffic; in fact, experience already shows that by being restricted to the area of the rails, tramcars frequently cause blocks in the traffic. The only alternative is therefore to have recourse to omnibuses or motor cars. There is already in operation between Kennington and Piccadilly a service of oil motor omnibuses, but they are rather noisy. This is, however, a difficulty which will doubtless be overcome at no distant date; and while we do not suggest that the particular type of omnibus employed on this route is the best for the purpose, there can be no question that, at all events for the central parts of London, the motor omnibus would be preferable to electric tramways.

An Electric Launch at the Paris Exposition.

Prominent in the Holland section at the Champ de Mars was an elegantly appointed electric launch, 52 ft. 6 ins. in length, exhibited by the Electrotechnische Industrie of Slikkerveer, Holland. It was the only exhibit of the kind. The hull was made of steel, and the woodwork of the cabin of teak, susceptible of a fine finish. A battery of 80 Tudor cells was used, having a capacity of about 400-amp.-hours, and allowing of a run of about 60 miles at a normal speed of 8 miles per hour. This is obtained when the several sections of the field are connected in series.

The motor specially designed for this class of work, has a four-pole field of the consequent-salient type, and upon each of the horizontal

FIG. 1.—DUTCH ELECTRIC LAUNCH.

salient poles are field coils in four sections. The normal capacity of the motor is 25 horse-power, but it will give up to 35 horse-power. The controller is placed in the bow of the boat, close to the steering gear, this arrangement being adapted for convenience in directing the movements of the vessel, as well as for a greater degree of safety. In front of the controller, their readings easily visible by the helmsman, are a voltmeter and ammeter, mounted on the bulwark frame. He is thus enabled to determine the amount of power which he is using, and a glance is sufficient to tell whether the current consumption is proportionate to the power developed, as indicated by the position of the controller handle. There are six notches on the controller. At the first notch, all the four double field coils are in series with the

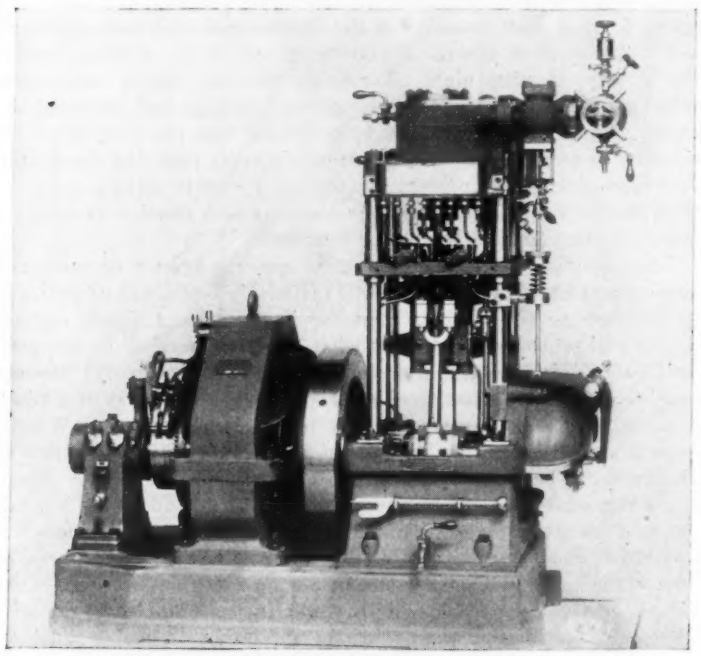


FIG. 2.—MARINE ENGINE AND DYNAMO.

armature and a resistance; at the second notch, half the resistance, at the third notch all the resistance is cut out; at the fourth notch two coils are in parallel and two in series; at the fifth notch three coils are in parallel, and at the sixth notch all four coils are in parallel—and, of course, always in series with the armature. The corresponding coils on each of the field bobbins are connected permanently in series, so that there are four sets of coils, electrically considered. The batteries may be charged all in series from 220-volt mains, or in two halves in parallel from 110-volt mains, special plugs being provided for this purpose. The current consumption for the six positions of the controller is 40, 50, 72, 110, 175 and 180 amperes, the voltage falling somewhat when the cells are discharged at the highest rate and the useful capacity being reduced one-half. Electric launches have the advantage over those propelled by steam or naphtha, in that they are not encumbered by the machinery, besides presenting other advantages such as quiet running, cleanliness and absence of smell. In the boat exhibited, space is provided for the batteries under the seats which run the length of the boat on either side, and the motor is placed below the main deck aft of the cabin. The weight, complete, of the boat is 10 tons, with room for forty passengers.

The Electrotechnische Industrie showed many other samples of their engineering products, among them a marine generating set consisting of a compound vertical engine direct connected to a four-pole 28-kw dynamo, also a smaller set with a single cylinder engine. In order to give a steady action, a heavy flywheel is keyed to the shaft between the armature and the inner engine bearing. Ample wearing surfaces are provided throughout, and the design both of engine and dynamo is well considered. The armature has a series winding of the Desroziers type, so that only two sets of brushes are required, placed on the upper side of the commutator. A sheet-iron case is provided for enclosing the crosshead and connecting rod, to prevent splashing of oil and to keep dirt from the guides.

Notes on Omaha Electric Lighting.

The new Omaha Thomson-Houston Electric Light Company has recently purchased the lighting plant at South Omaha, five miles distant from its Omaha station. The present plant at South Omaha will be turned into a sub-station fed from the Omaha station. The Omaha station has monocyclic alternators generating 2000-volt current at 60 cycles for distribution around Omaha. This will be stepped-up through two 275-kw transformers to 5500 volts to transmit to South Omaha. At the South Omaha sub-station two kinds of transformers will be put in. One set will supply a 106-212-volt three-wire network in the neighborhood of the station, and the other set will supply 2000-volt mains for residence lighting. Street lighting will be done as at Omaha with General Electric constant current alternating enclosed arcs. The constant current "tub" transformer for the South Omaha street lights will be located at the Omaha station and not at South Omaha. The Omaha plant now has five 100-light constant current transformers, allowing 80 volts per light.

The Omaha station is giving a monocyclic service for light and power and a 500-volt direct current power service. About 30 monocyclic motors are in use (the largest being 30 horse-power) and are giving excellent satisfaction. These motors are said to take more starting current than three-phase motors, but less than single-phase motors of similar capacity. The company is trying to get its new customers to buy monocyclic induction motors rather than direct current motors, and the experience of customers having the induction motors is such that it is not hard to get the induction motor introduced even though the price is higher than for the direct current motor. The attention and repairs required for an induction motor are, it is said, much less than for a direct current motor, since the average customer knows little about the care of that most vulnerable point of a direct current motor, the commutator. However, it is not expected that the company will be able to abandon its direct current service, because of the large number of electric elevators and the number of direct current motors now in use. The 500-volt direct current generators are direct connected on the same shaft as the monocyclic alternators. Thus there is one 750-hp McIntoch & Seymour tandem compound condensing engine running at 150 r. p. m. connected to a 500-kw alternator and a 325-kw direct current generator. There is also a 450-hp engine connected to a 300-kw direct connected alternator and a 325-kw direct current generator. These combinations enable the engines to run on an economical load most of the time. During the day when the load is light on the alternators, the 500-volt power generators are loaded, and vice versa. Two 300-kw alternating units are also in use, and a 500-kw alternator is soon to be added, all alternators of course being monocyclic. The alternators are usually run in parallel on the incandescent and power load and the street lights are taken care of by a separate unit. To throw alternators in parallel when one has no load on, the unloaded machine is throttled. The switchboard has two sets of bus-bars, so that machines can be partly loaded before being thrown in parallel if desired. The company is now under the management of W. H. McManigal.

The New Niagara Wheel Pit.

In the pictures herewith published is shown the second Niagara power wheel-pit at the end of one year's work on its construction. This pit was begun Nov. 12, 1899, and work has gone on continuously ever since. The pleasant weather of the past fall contributed materially to the advance made, and the pit has now reached a depth of

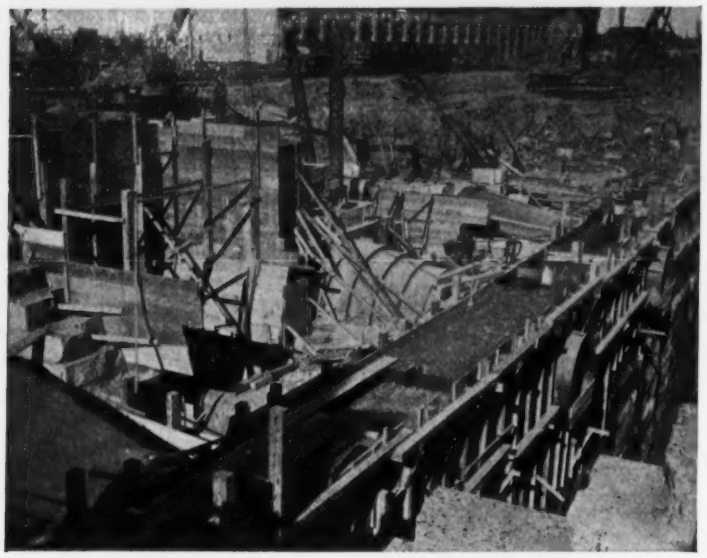


FIG. 1.—PLACING THE PENSTOCKS.

about 130 ft. As its approximate depth is to be 180 ft., it will be seen that there are about 50 more feet to be excavated, when such a view as now shown would be difficult to obtain.

Within a short time the Niagara Falls Power Company has awarded the contract for the construction of six new dynamos to the General Electric Company, and these machines are to be a portion of the eleven that are to be installed in the new power station over the pit shown in the pictures.

In one of the pictures will be seen the method of placing the penstock mouthpieces previous to the erection of the masonry walls in

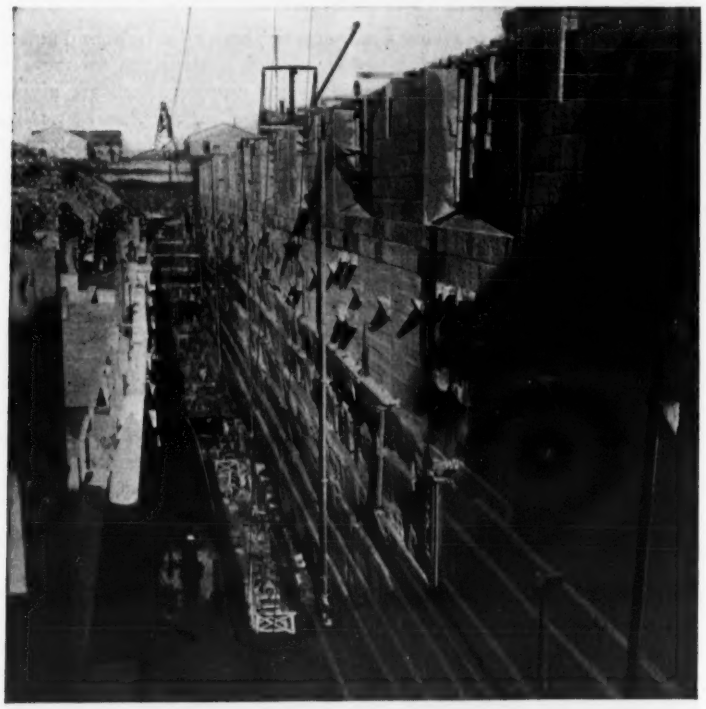


FIG. 2.—GENERAL VIEW OF THE NEW PIT.

order that they may be in position when the turbines are installed and the penstocks properly placed.

The second picture gives a graphic idea of the present depth of the pit, showing the channeled walls, the castings in place, and far below near the bottom is visible the "ring," where the water that flows through the rock is caught and at present pumped to the surface. The water that comes from this "ring" is remarkably cold and clear. The opening in the side of the pit, visible in the picture, is being bricked up, a section that has been bricked being seen at the far end.

Features of Telephonic Development in Nebraska.

The Nebraska Telephone Company, under the efficient management of H. B. Lane, has been enjoying a very prosperous year. During the past summer toll lines have been largely extended westward. The farthest point West in the State, McCook, now reached by toll line is 200 miles from the nearest Colorado line. Practically all the toll lines built by this company are copper metallic circuits. Several independent exchanges and toll lines have been bought within the past eighteen months. H. B. Storrs, superintendent of exchange construction, reports a healthy growth in nearly all exchanges in the State.

An interesting feature of the Omaha exchange is the city fire alarm and police telephone system, which is operated under contract by the telephone company at a saving of $5,000 a year to the city of Omaha The company secured this contract because it could afford to maintain the wires and apparatus in connection with its exchange much cheaper than could the city, which must have its own separate pole lines, linemen, central station and maintenance department. The city service is brought into one end of the exchange operating room where it is taken care by an operator who attends to that and nothing else. There are two classes of city service, one the ordinary Gamewell fire alarm box circuits, the other the police telephone service. In the latter a large number of patrol box telephones are put in series on one circuit. The removal of a receiver from the hook at any patrol box operates a signal wheel which gives the number of the patrol box from which the call comes, as on a fire alarm circuit. This is audible to the central office operator and at the same time is registered on a tape at the central office. The operator responds and takes the patrolman's message, whether it be simply a regular duty report or a call for fire department or patrol wagon. It is a significant fact, however, that more fire alarms come in over the exchange telephones than over the city alarm wires. All telephones on the Omaha exchange have a notice posted on them to call No. 37 in case of fire. It is not strange, and the fact mentioned indicates that to most people it is easier to find a telephone than to find an alarm box or a policeman in case of fire.

Another illustration of how the telephone can beat the telegraph if given half a chance, in some directions, was afforded the other day when W. B. T. Belt, manager of the Omaha exchange, settled a small bill with the State central committee of one of the political parties for services election night on election returns. Much satisfaction was expressed at the way the telephone company had delivered returns. Those returns received by telephone beat the telegraphic reports by twenty to thirty minutes in nearly every case, and the gentleman representing the committee expressed a wish to make a more extensive contract with the telephone company next election so as to receive all State election returns by telephone.

This company has not as yet gone into the matter of measured service very extensively. What little there is, is kept count of clerically by the operators. Manager Lane has in his office a simple register which will probably be used for what measured service the company will put in. It is a simple cyclometer counter with figures exposed enclosed in a small sheet steel box about one-half the size of a Blake transmitter. In the same box is a peculiarly sounding gong. When a subscriber calls for a number and before he is given his connection by the operator, he must turn his register ahead one number by inserting a key, which is furnished with the instrument, and giving it a half turn. This act at the same time taps the gong in the instrument, the sound of which notifies central that the call has been registered by the person calling. The necessity of having a key puts the use of the telephone out of the reach of those whom the subscriber does not wish to use the instrument, and avoids the annoyance of having outsiders use the metered service without paying for it.

Effect of Incandescent Light on the Eyes.

Consul Hughes, of Coburg, under date of Oct. 15, 1900, informs the Department that the medical faculty of the University of Heidelberg has made a very interesting report on the effect of incandescent light (gas or electrical) on the eyes. After having carefully weighed all the pros and cons of the question, the verdict is that the incandescent light is not harmful. For lighting large halls or places of entertainment, electricity is recommended from hygienic points of view.

Tests of the Electric Plants of the Battle-Ships Kearsarge and Kentucky.

In a paper read last week before the Society of Naval Architects and Marine Engineers, Naval Constructor J. J. Woodward, U. S. N., gave a very full account of the tests made of the electric plants of the Kearsarge and Kentucky, a description of which appeared in our issues of Nov. 25 and Dec. 2 and 9 of last year. Mr. Woodward gives generous credit to his assistant, Mr. J. J. Crane, in the matter of the tests, to whom he says all credit belongs for the form in which the record has been prepared. In the report, a description of each test is given in full under the heads of "object," "method of procedure," and "results." The appendix contains full data records of the tests, in some instances accompanied by sheets of curves.

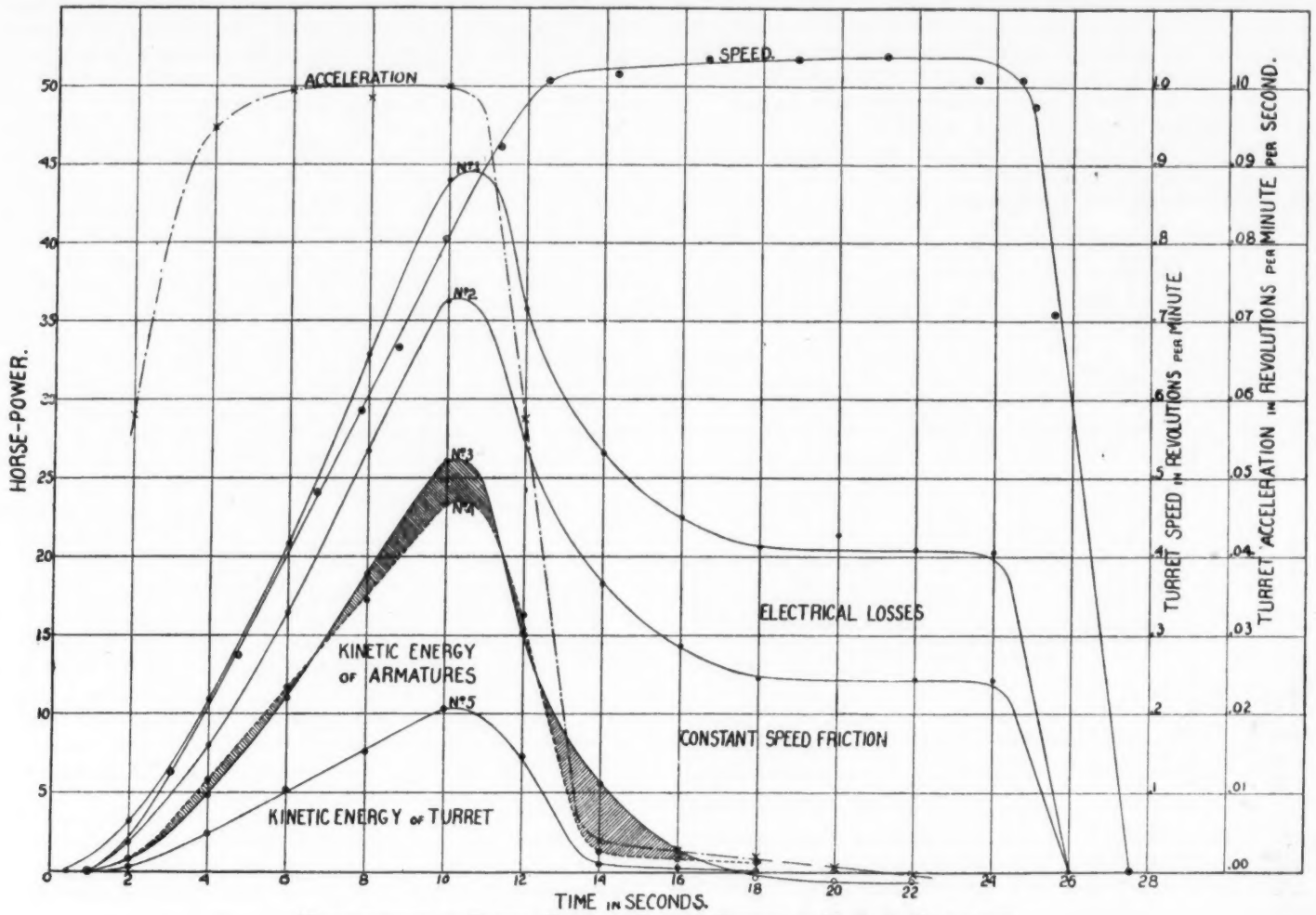
The total weight of the electric outfit of each of the battleships is 201.53 tons, and the electrical machine equipment is as follows: Seven 50-kw generating sets; two 100-hp turret-turning electric motor equipments; four 13-inch electric ammunition hoists; four 13-inch rammer electric motor equipments; four 13-inch electric motor elevators; four electric smoke blowers; four 8-inch electric ammunition hoists; four electric boat cranes; two compound geared electric deck winches, and four simple geared electric deck winches; ten 50-inch electric blowers; three exhaust electric blowers; ten chain ammunition hoists; two 6-pounder ammunition winches. There are in addtion four search-light equipments and a complete electric equipment for interior communication, and two Ardois signal sets. For the power circuits, 14,47[illegible] pounds of conductor were used and for the lighting circuits 3600 pounds, and 7094 pounds of wire were used for interior communication circuits.

A reading of the report shows that in all essentials the entire electric equipment of the battleships is an unqualified success. In some of the minor apparatus it has been found necessary to modify a few of the details, but the changes were not important in character.

The most interesting parts of the report relate to the tests of the turret electric equipment, and to an economy test of the generating plant. As is well known, the Ward Leonard system of electric control is applied to the turret-turning control. Owing to the frequent misunderstanding of this system, it may here be repeated that it depends upon the supply to the working motors of a variable e. m. f. by means of which to vary the speed of the motors. As the field of the motors remains constant, it follows that, for example, if the e. m. f. supplied to the motor is reduced, the speed at which the motor will run is necessarily reduced in order that the counter e. m. f. generated shall correspond to the impress. In the case of the plants of the war-ships, the variable e. m. f. is obtained by varying the field of one of the main generating sets, by the introduction of resistances controlled from the turret station.

The weight of the turrets is 650 tons, the turning power being supplied by two electric motors each rated at 50 horse-power. The remarkable sensitiveness of the method of control used is illustrated by the result of the test of minimum arc of train. It was found that a movement could be obtained as small as .01 inch at the circumference of the turret, which corresponds to a length of arc of only 2.1 ins. at 1000 yards range. Indeed, in the tests on the Kentucky, a movement of but half this was obtained nine separate times. It was found that the turrets could be revolved at the rate of one revolution in 58 seconds of time.

An interesting curve, which we herewith produce, is given showing the distribution of the power supplied to the turret motors. Curve No. 1 represents the electrical input; subtracting the electrical losses



DISTRIBUTION OF POWER, FORWARD DOUBLE TURRET OF U. S. S. KEARSARGE.

gives curve No. 2, or the motor mechanical output, and subtracting from this the friction loss gives curve No. 3, or the power available for acceleration. By calculation, the power required to accelerate the turret was determined and is represented by curve No. 5; curve No. 4 represents the power required to accelerate the turret and armatures, and the difference between the areas of curves Nos. 3 and 4 is the power required to accelerate the gearing. In other words, curve No. 4, represents the power converted into kinetic energy during acceleration and absorbed by the turret and armatures, while curve No. 5 represents the power converted into kinetic energy during acceleration and absorbed by the turret alone.

The economy tests of the generating sets developed results which, in view of the tests made on previous naval generating sets, are somewhat unexpected. Tests were made of two sets at full load, two sets at three-quarter load and three sets at half load. Each test was of forty-eight hours duration, during twelve hours of which a boiler test was made of the auxiliary boiler used; every six hours the engines were indicated and the output of the generator simultaneously measured. The quality of the steam delivered was determined by

means of a calorimeter, and pipe condensation was allowed for. The coal used was analyzed, and found to give 13,828.6 heat units per pound of coal. The results were as follows:

Efficiency of boiler, 74.6 per cent on the full-load run; 72.1 on three-quarters load, and 69.6 on half-load run. Steam per i. h. p. per hour corrected for moisture, 21.67, 21.79 and 25 pounds respectively for the three classes of tests; steam per kw-hour corrected for moisture, 33.91, 36.85 and 40.836 respectively. Coal consumed per i. h. p. hour, 2.36, 2.43 and 2.88 pounds; coal per kw-hour, 3.69, 4.1 and 5.58 pounds. The total steam per i. h. p. of engines per hour for generating sets and all auxiliaries was found to be 26.57, 26.75 and 29.5 pounds respectively, corresponding to a consumption of coal of 2.82, 2.92 and 3.35 pounds per i. h. p.

An Electric Elevator for the Washington Monument.

It had been proposed for some time past to substitute an electric elevator for the steam elevator service in the Washington Monument, which is so prominent an architectural feature of the National Capitol. The old system was objectionable in many respects, but at the same time the conditions of operation are so onerous as to render great caution necessary in making a change. We are now glad to note that after a very thorough study and investigation of the whole subject, the Government authorities have awarded a contract to the Marine Engine & Machine Company, of New York City, for an electric elevator equipment; although it is understood that most strenuous efforts were made to secure the adoption of an hydraulic equipment. It is, in fact, all things considered, a great victory for electricity, as it would hardly be possible to find a more conspicuous place or piece of work in the whole country.

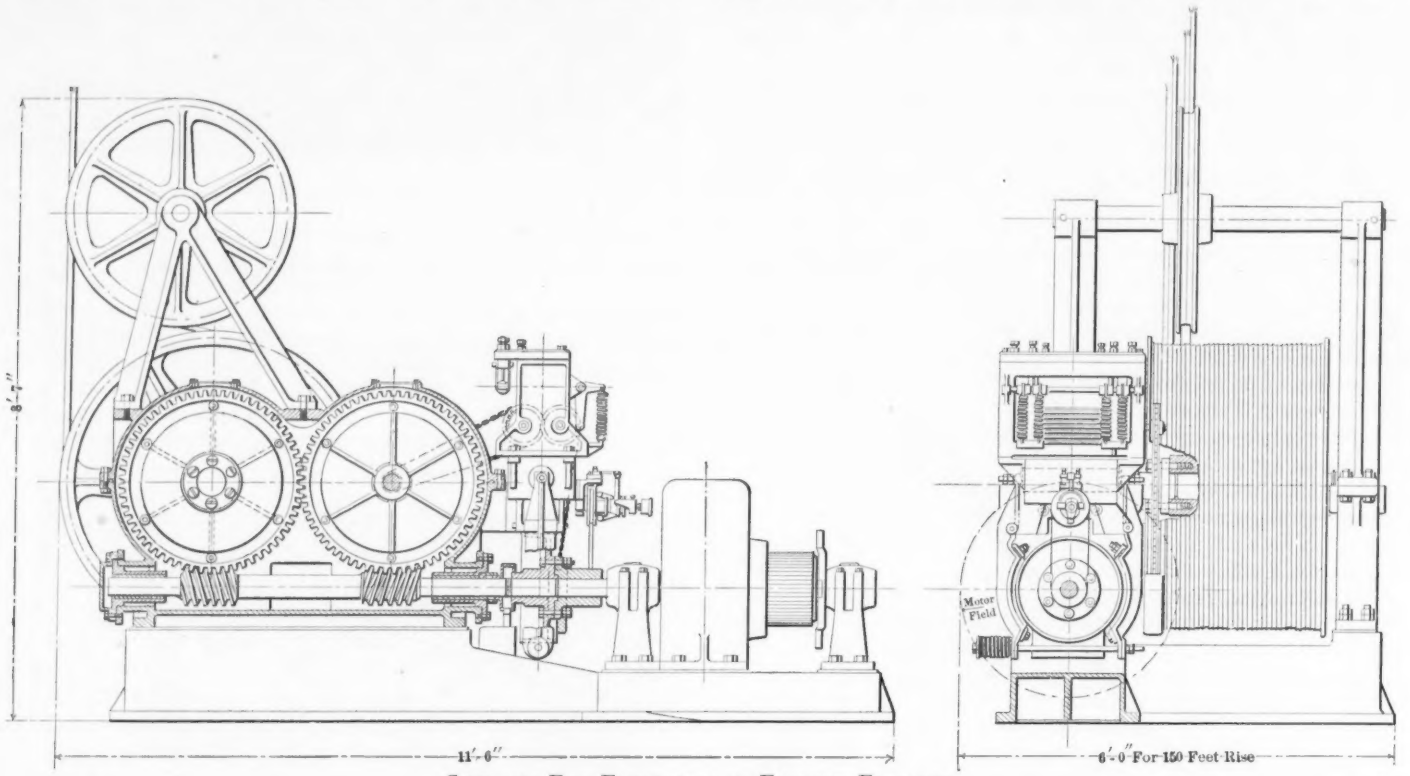
The rise in this case is 498 feet, and the speed with maximum load is 100 feet per minute. The load capacity is 6000 pounds and 2500 overbalance. The elevator car is to weigh 4000 pounds and to hold no fewer than 35 passengers. Mr. B. N. Jones, the electrical engineer of the company, is specially charged with the supervision of the work, which is to be done in 100 working days. The car is to be lighted with a cluster of 6 lamps of 16 candle-power fed from a separate circuit. The total of the contract is about $15,000, the car costing about $750. The motor is of 40 horse-power, 230 volts, direct connected, direct current. The design of the elevator system in general is that of Mr. C. R. Pratt, whose name is so well known in electric elevator work. Special new safeties are provided for, which will stop the car when loaded up to 80 pounds per square foot, without counterbalance, within 6 feet travel after the release of the safeties. The elevator is, however, to be counterweighted, with the cables in additional grooves on the drum. The grooving of the drum is to be effected by electric cutter. While this may not be necessary on ordinary elevator worm angles of about 5 degs., it is absolutely necessary on the angle of 16 degs that is used in these spiral gears. The arragement specified not only saves a loss of about 10 per cent friction by avoiding the use of an additional spur gear reduction, but the worm angle of 16 degs. should, by all reliable data on worm gearing, give about double the efficiency of the usual angle of 8 or 10 degs. The efficiency therefore of the arrangement should be about 20 degs. higher than could be obtained with any worm gear elevator of 8 or 10 degs. angle driving the drum through two pairs of spur gear.

The controlling devices specified consists of a solenoid resistance regulator and two magnetic circuit breakers. A "speed" relay is provided for varying the strength of the shunt field; also a circuit breaker relay working in conjunction with the solid resistance regulator, which makes it necessary for the controlling apparatus to return to normal starting condition at every stop of the car, or on a reversal of the car movement, before starting again.

Mr. C. A. Benton, the general sales agent of the Marine Engine & Machine Company, has given special attention to this interesting equipment, and is to be personally congratulated for securing an order of such importance, especially in view of the fact that this new company has barely yet entered the field of electric elevator work.

power and to go on while the regular use of the present elevator system is made, so as to interfere as little as possible with present operation. A special switchboard of Tennessee marble is provided, the equipment comprising a Cutter I. T. E. double-pole circuit breaker.

The contract calls for a Type A hoisting machine with right and left hand spiral gears meshed together, with right and left hand worms on the worm shaft. The worm shaft is coupled direct to a Crocker-Wheeler motor of the medium speed mutipolar type, shunt wound. The worms are a solid part of the worm shaft, which is made of high carbon hammered steel. The spiral gears are made of the best bronze, cut very accurately and bolted to solid cast iron spiders. The driving gear shaft is made of high carbon hammered steel with flanges forged on to which the driving gear spider is bolted with reamed coupling bolts. The bed is in one solid casting, on which are bolted the motor and gear case. By the use of spiral gears, a reduction is obtained of 20.6 to 1 with the low armature speed of 625 r. p. m., the spiral gear shaft being coupled direct to the drum pinion shaft and running the car at 100 feet per minute. The only other means, it is said, of obtaining this reduction on a worm gear elevator properly designed, would be by using a single worm gear or tandem worm gears interlocked by additional spur gears. Where tandem gears interlock, the only means of obtaining contact the whole length of the face of the teeth is by cutting the teeth on a spiral gear



Side and End Elevations of Electric Elevator.

CURRENT NEWS AND NOTES.

PACIFIC CABLE.—The bill enabling New South Wales to join with the other colonies of Great Britain in the construction of the Pacific cable has passed all stages of the Colonial Legislature without opposition.

TICKER SERVICE.—It is stated that an agreement has been reached between the Board of Trade and the Western Union and Postal Telegraph Companies whereby the ticker service by the latter will soon be resumed.

THE TELEPHONE IN GEORGIA.—The Georgia Railroad Commission, in its annual letter to the Governor of that State, has recommended that the telephone companies in Georgia be placed under the control of the Railroad Commission, as the telegraph and railroad companies are.

AMERICAN MACHINERY.—A special despatch from London of Nov. 16 says: "The United States machinery exhibit at the Paris Exhibition has been bought in its entirety by a Lancashire engineering firm and will be re-erected in Lancashire." No details of the transaction have yet been received.

INSTITUTE MEETING.—The American Institute of Electrical Engineers will hold its next meeting on Friday, Nov. 23, at 12 West Thirty-first Street, New York. Mr. B. A. Behrend will read a paper entitled "The Mechanical Forces in Dynamos Caused by Magnetic Attraction," and Mr. Henry Floy will read a paper on "The Plant of the St. Croix Power Company of Wisconsin."

WIRELESS TELEGRAPHY IN THE NAVY.—Rear Admiral Bradford, Chief of the Bureau of Equipment, Navy Department, recommends in his annual report the installation of wireless telegraph outfits on board ships of the navy. The report states that during the yacht races last year the Department directed a board of four officers to observe the working of the system, and their report was very favorable toward it. After a careful study of the system the Bureau is convinced that its chief value is for use at sea for the purpose of communicating between ships and between ships and shore stations, and believes that it will be of much value to the navel service in this connection.

AN ACCIDENT AT MONTREAL.—A large part of the dam at the Chambly power plant was washed away a little before midnight on Friday, Nov. 16. The Royal Electric Company, which employs the current from the disabled station, started up its auxiliary steam plant, and within five minutes after the time of the accident every light in the city was again burning. Considerable current is purchased for power from the operating company, and these circuits were running the first of the week. Much damage was done to the dam, and as the winter has already set in—a heavy snow and wind storm occurring on the night of the accident—it may be many months before the repairs are completed.

THE OLD COLLINS LINE.—The steamer Amur, from Skaguay, brought the men who have been working on the Government telegraph line to Dawson. These Northern linemen, who have suspended work until spring, found traces of an inter-continental line which was projected and actually begun, to connect North America with Europe by way of Siberia. On the summit of a mountain, near Telegraph Creek, they found a stake, or surveyor's picket, which marked the old enterprise, and they also discovered the remains of old wire which is still up in places. The late F. L. Pope and George Kennan, the writer on Siberia, worked on the construction of this old land line, killed off by the Atlantic cable.

ILLINOIS STATE ELECTRIC ASSOCIATION.—The first annual meeting of the Illinois State Electric Association will be held at the University of Illinois, Champaign, Ill., on Nov. 27, 1900. The morning business session will be followed in the afternoon by an illustrated lecture on some of the most recent developments and discoveries in electricity. A tour of inspection will be made by the members of the association, including the scientific and engineering laboratories and other points of interest about the university. The association was organized at Springfield, Ill., April 24, 1900, and represents in its membership the leading electric light and power industries doing commercial business throughout the State. Mr. H. E. Chubbuck, Quincy, Ill., is secretary.

INCANDESCENT LAMP FILAMENT.—A patent issued Nov. 13, to Carl Kellner, of Vienna, Austria, describes an incandescent lamp filament by means of which it is claimed that a greater proportion of the energy supplied in the form of electricity may be converted into light and a less proportion into heat. A highly infusible metal, such as thorium, in the form of a dry powder, is placed in a press mold and formed into the desired shape under very high pressure. The filament is then oxidized at its surface by being made to glow by immersion in an oxidizing liquid or by being inserted as an anode in an electric circuit which decomposes an electrolyte of which oxygen is an anion. The thin layer of oxide adheres firmly to the metal. Another kind of filament consists of a mixture of graphite of high density with metallic oxides, as by molding and pressing a mixture of powdered oxides capable of emitting light and of a small addition of cellulose soaked in chloride of zinc. By means of a current of high potential the amorphous carbon is converted into graphite of high density before the incandescent lamp is put into use.

"SOUND MONEY."—It is not the province of this journal to invade the field of the humorous publication, but the following telephone incident which actually happened the other day in Omaha is too good to keep. The Nebraska Telephone Company at that place has automatic pay station telephones into which the person desiring connection can drop "coins" of different denominations according to the value of the toll service asked for. One of the instruments at a prominent Omaha hotel was one day visited by no less a person than the assistant secretary to one of our United States cabinet officers. Said assistant secretary deposited in the slot three Nebraska Telephone Company 25-cent telephone tickets. Naturally the coin mechanism failed to respond to any such paper stuffing as this and the operator would not give the gentleman his connection, he maintaining meanwhile that he had put his money in and she maintaining that she had heard nothing of it. Finally, when General Manager Lane was called up and the gentleman related in what way he had fed the machine, the desired connection was given and an assistant was sent down to unstuff the slot.

THE KENTUCKY'S TURRETS.—Several weeks ago an item appeared in these columns stating that the United States battleship Kentucky had experienced some trouble with her turrets. According to the newspaper accounts from which the item was compiled, the turrets stuck so fast that they could not be moved by the electric motors after a discharge of the 13-in. guns in the lower turrets. We are glad to learn from an authoritative source that any implication in this statement as to inefficiency in the operation of the turrets or guns is entirely unwarranted, the defect developed being minor in character and one which could readily have been overcome by the ship's force. It appears that on the test of the turret guns at the proving grounds it was found impracticable to fire them with the muzzle depressed owing to the nature of the proving range, and when tested at sea it was found that when depressed the gun ran out too hard. The defect was very simply remedied by an adjustment of the counter-recoil checks and an easing up in the piston by a slight filing. As will be seen, the electrical portion of the turret equipment was not involved. Owing to the prominence which the matter was made to assume in the newspaper press, a suspicion is awakened that advantage was taken of a slight defect by enemies of the double-turret system with the hope of discrediting generally the system in the eyes of the public.

ELECTRIC METER.—A patent was issued Nov. 13 to G. W. G. Little, of Heckington, England, on a recording electrical meter, in which no magnet is employed for the dissipation of energy at a time when the accuracy of the meter can be affected by any variations in the strength of the magnet, by this means obviating the errors said to be incident to the use of such magnets owing to their variation of strength. Instead of dissipating the energy at a time when the strength of the magnetism can affect the accuracy of the record, the dissipation is caused to take place at a time when the wattmeter is

not making its movement for indicating or recording. By means of gravity or a spring the energy given out by the moving parts of the wattmeter are stored up and then dissipated during the time that the movable part of the wattmeter is idle or not acting upon the indicating or recording mechanism. Means are provided whereby a fraction of the energy electrically given to the moving coil of the wattmeter is magnetically transmitted to a shaft or spindle which, on receiving such energy, has movement of rotation imparted to it, and in moving raises a weight or coils up or deflects a spring of uniform reactive effort. After the shaft or spindle comes to rest, it has, under the reaction of the weight or the spring, a movement of rotation in the opposite direction, the weight or spring returning to its normal position. It is during this return stroke that the dissipation of the energy takes place, which dissipation can be effected by mechanical friction or magnetism or by both.

REISSUE OF A VAN DEPOELE PATENT.—A reissue was granted Nov. 13 of a Van Depoele patent for a traveling contact for electric railways. The original patent (No. 495,443) was issued April 11, 1893, as a division of an application upon which another trolley patent was issued April 1, 1890, which has figured largely in electric railway litigation. This latter is known as the suspended switch patent, and has been sustained in a number of suits, among which were cases against the Columbia Machine Works, the Union Railway Company, the Worcester & Clinton Street Railway Company, the Central Union Brass Company, and the Elmira & Horseheads Railway Company. In the preamble of the patent reissued it is stated that in the patent just referred to the devices for switching traveling contact from one conductor to another have been claimed, and that the second patent relates more particularly to an improved traveling contact. In the original patent there were sixteen claims, which have been reduced to two in the reissue. In the specification of the latter those parts appearing in the original patent relating to the tension device whereby the traveling contact wheel is kept always pressed against the under side of the trolley are omitted, and a paragraph added stating that this device has already been claimed in the patent No. 424,695, or the one referred to as having been involved in important litigation. The two claims in the reissue which replace the sixteen claims in the original cover a laterally swinging and upwardly extending trailing arm mounted on the roof of a car and carrying a contact device at its free end for making underneath contact with the trolley; such arm being supported on the car on vertical and transverse axes so as to permit the contact device to follow the position of the conductor, notwithstanding great variations of height and of lateral displacement.

AUTOMATIC STEERING DEVICE FOR TORPEDOES.—In a patent granted Nov. 12 to Mr. Caryl D. Haskins, an automatic steering device for torpedoes is described, consisting of means for controlling the rudder of a torpedo by a magnetic device subject to the determining influence of the vessel or other object at which the torpedo may be aimed. The mechanism includes a timing device for bringing the apparatus into action only after such a lapse of time as will allow the torpedo to get out of the range of the magnetic influence of the discharging vessel or station, and come into the range of the influence of the ship or other object aimed at or attacked. The apparatus consists essentially as follows: A long iron bar in the centre of the vessel and parallel to its longitudinal axis has adjacent to one end and on opposite sides of the central line of the torpedo, two differential coils of exactly equal capacity and arranged in inductive relation to the bar. Beginning at a definite time after the starting of the torpedo the iron bar is intermittently magnetized by means of a circuit breaker and an electric current. It is apparent that so long as there is no disturbing magnetic influence, the field of the bar magnet will be symmetrical and its inductive effect will be exactly equal upon the two coils opposite its end so that no current will be produced therein. In the event, however, of some magnetizing body like an iron ship being present in the neighborhood of the torpedo, such magnetic mass will disturb the symmetry of the magnetic circuit of the bar so as to produce a predominant inductive influence on one or other of the two coils opposite its ends. There will then be an induced current in the circuit of the coils which will be in one direction or the other according to the side upon which the external magnetic mass exerts its influence. This current will serve to energize one or the other side of a sensitive polarized relay and cause it to close the circuit of one or more magnets controlling a rudder motor, thus influencing the steering of the boat.

MULTIPLE UNIT TRAIN SYSTEM.—A patent granted Nov. 13 to Charles B. Martin, describes a multiple unit train system in which a main supply system runs through the train and connects to each motor equipment, the system being so arranged that the flow of current to all the motors may be controlled from a single controller. The master controller comprises a common or main controlling switch directly controlling the flow of current from the source of supply to the motors, and of a plurality of auxiliary controlling devices indirectly controlling the circuit connections of each of the motor equipments by the means of circuit changing switches on the several cars. The devices of the ordinary car motor controller for reversing the motors, changing from series to parallel relation, etc., are removed from the controller proper and circuit changing switches performing these functions are placed on each of the motor cars, the operation of these switches being controlled by auxiliary controller switches associated with the main controlling switch of each controller. The direct function of the controller is primarily to close and open the connection from the main lead to the source of supply, both in stopping and starting the car and at any other proper time, as in shifting from series to parallel, or vice versa. A subsidiary function is the adjustment of resistance in this connection so as to control and graduate the current supplied to the motors. The other functions of the controller are performed indirectly through its connections with the electromagnetic actuating devices of the separate circuit changing switches of the several motor cars. The circuit changing switches are operated when no current is flowing in the motor circuits, and to this end the controller system is independent of the main supply system, and the main controlling switch so arranged that the connection with the source of supply may be broken before the circuit changing switches are operated, thus bringing the brunt of the arcing on the master controller and practically under the eye of the motorman.

LETTERS TO THE EDITORS.

Variation of the Force of Gravity and the Readings of Electrical Instruments.

To the Editors of Electrical World and Engineer:

Sirs:—What effect the variation of the force of gravity, at different places, has on the readings of electrical instruments, is a question that is frequently asked by electrical students. While it is an old question, and gets an old answer, it may be of interest to some.

The coefficient of acceleration, g, due to gravity, varies about one-third of one per cent throughout the United States, and a still larger variation exists between some parts of Europe and this country. All electrical instruments depending upon gravity as a restoring force, will have the same percentage of error in their readings that exists between the values of g for the place of standardization and the location of the user. If g is larger at the place of use than at the laboratory, where the instrument was standardized, the readings will be too small and must be increased by the percentage of increase of g. This is readily seen from the equation of moments of the two forces and their lever arms.

$$ELk = M\,g\,L'$$

$$E = \frac{M\,g\,L'}{L\,k}$$

where E represents the force due to the electric quantity to be measured, L the lever arm of the electric side of the balance, M the mass on which the gravitational force is to act, L' its lever arm, g the acceleration of gravity, and k a constant of the instrument. From this it is evident that as g increases, for the same mass and lever arms there must be a larger electric force to balance it, and consequently the reading must be increased.

One of the most common type of instruments subject to this variation is the Kelvin balance, where the current is gotten from the formula

$$I = 2\sqrt{d\,k}$$

where I is the current in amperes, d the reading of the movable scale, and k is a constant dependent on the gravitational force exerted upon a weight, for its true value, and given a constant value for the place of standardization, Edinboro, usually, where g is 981.5. It is readily seen how to apply the correction to k, increasing, or decreasing it the percentage variation of g.

The following table gives the values, for a few places in the United States, of correcting factors to be multiplied into the instrument readings, the product being the correct value of the electric quantities observed:

Allegheny, Pa.	.99854	Ithaca, N. Y.	.99872
Boston, Mass.	.99882	Philadelphia, Pa.	.99862
Chicago, Ill.	.99868	Princeton, N. J.	.99858
Cincinnati, Ohio.	.99842	Terre Haute, Ind.	.99849
Cleveland, Ohio.	.99866	Washington, D. C.	.99853
Denver, Colo.	.99802		

It is frequently supposed that a correction of the same character is necessary when using a silver or copper voltameter, but this is not the case, as in this instance it is purely a question of mass of silver, or copper, deposited per unit quantity of electricity, this mass being compared later, by weighing in a balance with a known mass. The variable force appears on both sides of the equation of moments,

$$M\ g\ L = M'\ g\ L'$$

where M is the standard, or, rather, known mass; M' the mass to be measured, g the value of the acceleration due to gravity, and L, L' are the lengths of the two lever arms of the balance.

The two illustrations given are sufficient to indicate the kinds of instruments affected and methods of correcting this variation.

WESTERN UNIVERSITY OF PENNSYLVANIA. S. M. KINTNER.

Large Dynamos at the Paris Exposition.

To the Editors of Electrical World and Engineer:

Sirs:—In your issue of Oct. 6 is an article quoting from Prof. S. P. Thompson, on large dynamos at the Paris Exposition, in which he referred to one of the machines as being made by the Russian branch of Siemens & Halske. This, however, is an error, as the machine in question was built by the Viennese works, as you will see from the printed matter sent herewith. SIEMENS & HALSKE.

VIENNA, AUSTRIA.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Starting Induction Motors.—DERI.—A continuation of his illustrated article, abstracted in the Digest Oct. 13. As noticed there, he uses a different number of poles at starting than when running. The best results are obtained when the two numbers of poles are 4 and 6, or 6 and 8, or 8 and 12, etc.; the condition which must be fulfilled is that if the two numbers are divided by their greatest common factor, one quotient must be odd, the other even; for instance, 8 and 12, divided by 4, gives 2 and 3. Fig. 1 shows the arrangement of the armature windings of a single-phase alternating current motor, for 4 and 6 poles. The armature represents a Gramme ring for 4 poles, which are used for starting, and represents a short-circuited armature for 6 poles. This arrangement is analogous to Figs. 1 and 2 in the

FIG. 1.

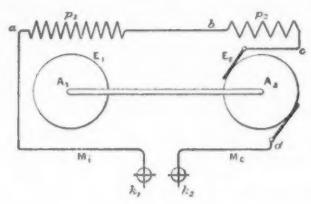


FIG. 2.

Digest Oct. 13, the principal difference being the use of the vollector and the brushes which are necessary to obtain the starting torque of the single-phase motor; for a polyphase motor, the collector and the brushes become superfluous. He gives a diagram of a switch for changing from 4 to 6 poles; it is on the principle analogous to that shown in Fig. 3, Digest Oct. 13. He also describes a recent arrangement in which he produces a complex field equivalent to the superposition of two fields with different numbers of poles: in this way he obviates any changing of connections by a switch. Such a machine consists of a combination of a motor with a collector and a motor with a short-circuited armature; this may be done in two different ways. One is shown in Fig. 3, where, for the sake of clearness, the two parts are shown separately. M_1 is the group of windings which form the induction motor, with the number of poles p_1; Mc is the other group with the number of poles p_2. The armature of A_2 is in this case in series with the field windings; k_1 and k_2 are the terminals of the supply circuit. Fig. 3 is a diagram of a combination of a 4-pole and of an 8-pole motor. How this operates may be seen from Fig. 2. If an alternating current is supplied to the terminals k_1 and k_2, the potential differences are divided in such a way that between the points a and b there is a small tension at starting, while between b and c the tension is high. Therefore the motor with the collector is first acted upon. When the speed of rotation increases the tension between a and b increases and the short-circuited armature induction motor begins to operate gradually. A number of motors, based upon this principle, are in use in Vienna and Budapest for elevator service.—*L'Ind. Elec.*, Oct. 10.

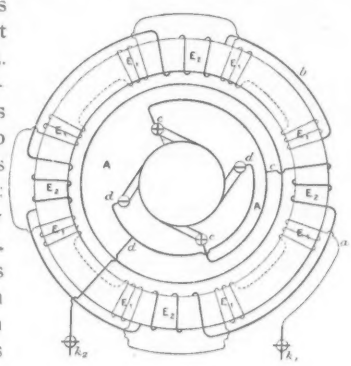


FIG. 3.

Bucking of Large Shunt-Wound Motors.—A brief article on the behavior of a 300-kw shunt motor, used in Kansas City on a cable road. The load imposed by the cable is widely variable; when the motor was installed it responded by bucking and flashing viciously at the commutator when sudden heavy loads were thrown on. The remedy was to use a series winding on the field magnet of such a direction as to strengthen the fields with increasing load on the motor. —*Am. Elec.*, Nov.

Constant Potential Direct Current Converter.—DAVIES.—A communication in which he suggests modifying his proposal (Digest, Nov. 10), as follows, in order to avoid sparking at the brushes. He proposes to let the armature winding be the converse of that described before, so that the primary armature coils are chord wound and the secondaries have the full pitch; also to provide each magnet pole with two slots and to wind the compensating coils on the two polar horns, connecting them so as to assist the shunt winding.—Lond. *Elec. Rev.*, Nov. 2.

REFERENCES.

Voltage Regulator.—CHAPMAN.—An illustrated description of a new voltage regulator, in which electromagnets move contact shoes, which, in sliding along segments, vary the resistance in the field circuit of the generator.—*Am. Elec.*, Nov.

Induction Motor.—BROCKSMITH.—An illustrated article, giving a design for a 1-hp single-phase induction motor.—*Am. Elec.*, Nov.

Commutation.—HAWKINS.—The conclusion of his mathematical article, noticed in the Digest Nov. 17. He concludes the discussion of the short-circuit equations and discusses the mathematical conditions of sparklessness and the use of a high brush-contact resistance. —Lond. *Elec.*, Nov. 2.

LIGHTS AND LIGHTING.

Direct Current Arc.—MRS. AYRTON.—A long illustrated abstract of her Internat. Elec. Congress paper on "The light emitted by the continuous current arc," which was more briefly abstracted in the E. W. and E., Sept. 15, p. 410.—Lond. *Elec.*, Oct. 12, 19.

A brief communication by Mrs. Ayrton on the increase of the absorption with increased arc length, in which she sums up her argument as follows: In all arcs, both long and short, the carbon vapor emitted by the crater is turned to carbon mist at an almost infinitely

short distance from the crater. This mist she supposes to consist, not of liquid drops like water mist, but of tiny solid particles like smoke. In a short arc, a comparatively thin layer of these condensed solid particles has to be traversed by the crater light, and hence a comparatively small portion of that light is absorbed; but the longer the arc, the thicker is the layer of mist, and the greater therefore is its absorbing power.—Lond. *Elec.*, Nov. 2.

Incandescent Lamp Shades.—W. L. SMITH.—A long paper giving an account of "A study of certain shades and globes for electric lights, as used in interior illumination." The paper is fully illustrated with figures and diagrams and gives in tables the results of tests, based principally upon mean spherical candle-power. He concludes that the Holophane type of shade is very greatly superior in general results to any other investigated. The Holophane type aims at both diffusion and directive action on the rays of light given off by the enclosed lamp, and at such a thorough softening of the light as to render it possible to see objects comfortably. This is accomplished by two systems of cutting one on the inner and the other on the outer surface of the shade. That on the inner is a system of ribs, running vertically; the outside system consists of parallel prisms, one above the other.—*Technol. Quart.*, Sept.

REFERENCES.

Mougin Arc Lamp.—An illustrated description of the new Mougin arc lamp, which was exhibited at the Paris Exposition. It is specially adapted for use on board ship, and its action is independent of the force of gravity. The carbons are moved by means of a rack and pinion mechanism, driven by a spring, which is released by an electromagnetic device.—*Elek. Anz.*, Oct. 14.

Incandescent Lighting.—SONNEBERG.—An article "On the comparatively slow growth of electric incandescent lamp service." He refers to the fact that sometimes electric lamps are displaced by incandescent gas lamps on account of the price. He urges that the central station manager should bring to bear every effort in order that the lights on his system be kept at a standard, and gives some hints showing how to do this.—*Am. Elec.*, Nov.

Electric Lamps.—BLONDEL.—A long abstract of his Internat. Elec. Congress paper on the progress in electric arc and incandescent lamps noticed in the E. W. and E. Sept. 15.—Lond. *Elec.*, Nov. 2.

POWER.

Water Power Plant in the South.—McKISSICK.—An illustrated description of the water power plant of the cotton mills at Pelzer, S. C. There are three 1000-hp three-phase generators, the voltage being 3600, the frequency 60. The current is transmitted to a mill which was formerly driven by a steam engine and has now been supplied with a synchronous motor, and also to another mill, where it is transformed and supplied to 28 induction motors; in the spinning and carding rooms, motors of the squirrel-cage type are used on account of the excessive lint and flyings in these rooms; all the other motors are of the clutch type, with variable resistance in the rotating secondary circuit. In order to increase the power factor of this plant, a 400-kw rotary condenser is used, which is simply an overexcited synchronous motor, running free; the amount of power that it saves by the reduction of heat losses in the transformers, line and generators, and in the diminished exciting power required for the generator, practically balances the power required for the operation of the condenser motor itself; the power factor of the plant with full load on, without the condenser motor, is 86 per cent, and with the condenser it is 94 per cent; in a test in which the e. m. f. at the motor terminals was kept constant, the generator e. m. f. was 3780 volts and the current 435 amperes, without the condenser motor, while with the condenser motor these values were 3690 volts and 402 amperes.—*Am. Elec.*, Nov.

Indian Water Power Plant.—An illustrated article on the Cauvery Falls installation, which is the first actual scheme that has been definitely settled upon in India. It is being carried out by the General Electric Company, of this country. The power is to be utilized for working the gold fields of the Kolar district of Mysore. The generators will consist of six complete units of 1000 horse-power each, each unit comprising a water wheel and generators on a horizontal shaft. The generator will work at 2200 volts. Step-up transformers will raise the voltage to 30,000. At the receiving end of the line, step-down transformers will reduce the voltage to 4000 for distribution purposes. At each mine secondary transformers will further reduce the voltage to between 150 and 200.—Lond. *Elec. Rev.*, Nov. 2.

Kander Water Power Plant.—RUPP.—A long illustrated description of the plant at the River Kander, which has been erected by Brown, Boveri & Company. At present about 3600 horse-power are changed into electrical energy. There are five turbine-driven 620-kw generators, giving three-phase currents at 4000 volts. Each is excited by a 12-kw direct current dynamo on the axle of the generator; the fields of three exciters are excited by two 14-kw turbine-driven dynamos. The currents are distributed to the places in the neighborhood at 4000 volts, while they are transmitted to Bern and Burgdorf at 16,000 volts. This plant also furnishes the current to the Burgdorf-Thun three-phase railway.—*Elek. Zeit.*, Nov. 1.

Transmission Plants for Rural Districts.—EHNERT.—An article in which he discusses the choice of the site of the power plant and of the system and voltage for a transmission to several small villages in a rural district. For choosing the site of the plant, the existence of a neighboring water power or coal mine must, of course, be considered; to make the copper weight of the transmission lines a minimum, the centre of gravity of the whole system must be chosen for the plant. He discusses briefly the relative advantages of the single-phase, quarter-phase and three-phase systems, and concludes that in general the three-phase system is the best. He recommends using a voltage not lower than 5000, and to design the lines so that the variations of voltage remain within allowable limits if the load in one village is varied from zero to its maximum. He thinks aluminum could be used to advantage for the transmission lines.—*Elek. Anz.*, Oct. 14, 18.

Electricity in Collieries.—An article on electricity at the Vicoigne-Noeux collieries in France. They added to their works 60 coke ovens, and as they yield a large quantity of waste gas, it was decided to turn it to account for economically generating electric power to be utilized in the different departments. There are two generating dynamos, the first is a 250-hp three-phase alternator, the frequency being 50, the voltage 500; the second is a 500-hp three-phase alternator, the frequency being 50, the voltage 500. The current is used for power purposes. There is also an electric locomotive hauling cars which is provided with accumulators; for charging these the three-phase currents are converted into direct current by a converter. The power of the locomotive is 20 horse-power, the voltage 100, the number of revolutions of the motor 850, the ratio of gearing 1:6:9; the battery of 51 Tudor rapid charging cells has a capacity of 60 ampere-hours.—*Colliery Guardian; Eng. and Min. Jour.*, Nov. 10.

High Speed Elevators.—COCHRANE.—The conclusion of his illustrated paper on electric elevators for safe and economical operation at high speed. He describes the traveling-nut and multiple-sheave machine, also a double motor continuously running cable mechanism. He concludes that the general economy of operation of a winding drum machine, especially if equipped with a mechanically released brake, is far greater than that which can be obtained from either of the two machines just mentioned. He shows how to determine the diameter and length of drum to be used in a winding drum elevator machine for high speed.—*West. Elec.*, Nov. 10.

REFERENCES.

Power Generation.—J. B. C. KERSHAW.—A reprint in full of his paper on the comparative cost of power generation by the steam engine, water turbine and gas engine, an abstract of which was noticed in the Digest Oct. 6.— Lond. *Elec.*, Oct. 19, Nov. 2.

Electric Cranes.—An illustrated description of some American electric traveling cranes, with direct current or polyphase motors; also of the large crane of Flohr at the Paris Exposition, and of one in certain Swiss quarries.—*Elec. Rev.*, Nov. 7.

Power Plant of Railway Shop.—An illustrated description of the direct current central station for the car and locomotive shops of the Chicago & Northwestern R'y Co. for lighting and power purposes.—*West. Elec.*, Nov. 10.

TRACTION.

Railway Power Stations.—THONET and D'HOOP.—An abstract of their report, read before the International Tramway Congress, the object being to give the various methods used in central stations, and the practical results obtained as based on the replies from sixteen companies. In general the capacity of the station is double that necessary for maximum service; generators of more than 100 kilowatts are generally direct connected and compound wound; the average capacity for overloading is 25 per cent for 1.5 hours; with gas engines a storage battery becomes indispensable. The engines are generally compound, the speeds varying from 65 to 120; vertical engines

are seldom used. Steam pressure varies from 7 to 11 atmospheres; the choice of boilers is widely different, although the tubular boiler for large plants is generally preferred; mechanical stokers are not generally used; condensers are customary in both large and small plants; the best records for evaporation were obtained with boilers having interior fire boxes; the steam consumed varies from 5.72 to 8.67 kg. per indicated horse-power hour; the Corliss type is more economical than the slide valve engines. They conclude that large companies should use compound condensing steam engines direct connected to generators; also that it is generally advisable to install a storage battery in a small plant where fuel is expensive and where gas generators and engines give good results.—*St. R'y Jour.*, Nov. 3; Int. Ed., Nov.

Am. Street Railway Asso'n.—A report of the proceedings and discussion. One of the discussions was on the question of the relative advantages of the use of two as against four motors, on a double-truck car. Foster found four motors more desirable than two on some cars traveling at 30 miles per hour, but on lower speed lines he uses two motors; the four motors took more power, but the repairs were less. Harrington gave a table showing the watt-hours per car-mile with different equipments. Beggs stated that four motors took 20 per cent more current than two motors for the same work, but owing to the quicker acceleration the four motors are much more desirable; he uses them on all of his cars; the depreciation is also less. The subject is also discussed editorially.—*St. R'y Jour.*, Nov. 3; Int. Ed., Nov.

Electric Traction in Germany.—Among notes on several subjects, it is stated that the station of the large Berlin tramway uses four condensing engines, with cooling towers. Owing to the poor service given by the accumulator cars in that city, the company has been requested to replace the accumulator cars by the overhead trolley system and by the underground trolley for a few short lines. The suspended railway at the Wannsee has recently been opened and a short description is given; some careful tests are being made to determine the amount of power required and other similar data.—*St. R'y Jour.*, Nov. 3; Int. Ed., Nov.

Freight Automobile.—LOEWENTHAL.—An illustrated description of a new electric delivery truck of Altman & Co., New York. It is 14 ft. in length, weighs 6,000 lbs. complete, and has battery capacity enough to propel it over 20 to 30 miles on one charge. It is propelled by two 2-hp motors geared to the rear axle in a ratio of 12 to 128. It runs at a speed of from 7 to 8 miles per hour, and carries 4 people and a load of 2 tons.—*The Automobile*, Nov.

Storage Battery Cars.—BROCA and JOHANNET.—An abstract of their report to the International Tramway Congress, in which they discuss the progress made in the use of storage batteries for traction; the information obtained furnishes no direct conclusions; each case involves special conditions. In the replies that they received, few companies report the use of batteries, and only one uses them exclusively on any line.—*St. R'y Jour.*, Nov. 3; Int. Ed., Nov.

Car Heating.—DE BURLET.—An abstract of an Int. Tramway Congress paper showing that few improvements have been made since 1894 and concluding that stoves seem to be the simplest and most economical method of heating.—*St. R'y Jour.*, Nov. 3; Int. Nov.

REFERENCES.

Automobile Competition.—KALLMANN.—The first parts of a reprint of his long report on the competition tests of automobiles held in Berlin in April, 1900, an abstract of which was noticed in the Digest Nov. 17.—*Elek. Anz.*, Oct. 7, 11, 14, 18, 21.

Controller for Automobiles.—HANCHETT.—A brief article in which he gives a simple controller diagram showing a series parallel controller controlling two motors; it has six speeds and two running notches.—*The Automobile*, Nov.

Power Distribution for Electric Railways.—VAN VLOTEN.—An abstract of a paper read before the International Tramway Congress. He discusses the distribution by direct and alternating current and the combination of the two; the former is the simplest for short lines, but for longer distances the second is often the cheaper; a table shows the cost of installation and maintenance for several systems.—*St. R'y Jour.*, Nov. 3; Int. Ed., Nov.

Electricity on Tramways.—VON PIRCH.—A paper read before the International Street Railway Congress on the effect of introducing electricity on tramways. It deals with the advantages derived and shows that there is marked improvement in the traffic, operating expenses and net profits; more passengers can be carried, steeper grades can be mounted; more comfortable and larger cars can be used, etc.—*St. R'y Jour.*, Nov. 3; Int. Ed., Nov.

Conduit Line in London.—The London County Council has built a short section of conduit line about 256 ft. in length, for experimental purposes, using a system similar to that in New York; each car has two motors of 35 horse-power each.—*St. R'y Jour.*, Nov. 3; Int. Ed., Nov. (See ELEC. WORLD AND ENG., Nov. 3.)

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Frontier Electric Light Plant.—SHEPARDSON.—An illustrated description of the plant of the village of Gardiner, Park County, Montana, which has about 50 log houses and 100 inhabitants. There is a second-hand dynamo driven by a water wheel. Incandescent lights are furnished at the flat rate of $1 a month. The company has about 40 customers for light and water.—*West. Elec.*, Nov. 10.

REFERENCES.

Bury St. Edmunds.—A long illustrated description of the lighting plant of the town of Bury St. Edmunds. The direct current three-wire system is used. There are two steam dynamos, each of 60 kilowatts, and a storage battery giving 500 ampere-hours, when discharged in 10 hours.—Lond. *Elec. Eng.*, Nov. 2.

Water Rheostat.—An illustrated description of a practical form of a water rheostat, with hints showing how to construct and use it.—*Am. Elec.*, Nov.

Electric Installations on Board Ship.—FOERSTER.—An article, illustrated by diagrams, showing the arrangement of storage batteries on board ship in connection with a shunt or compound dynamo, as used by a German firm.—*Elek. Anz.*, Oct. 4.

WIRES, WIRING AND CONDUITS.

Welding of Aluminum Wires.—HERAEUS.—A very brief abstract of a paper read before the Electrotechnical Society of Frankfurt on a new method of welding aluminum wires. The end of an aluminum wire, when heated to a certain temperature below red heat, becomes viscous and can then be joined with the end of another aluminum wire, brought to the same temperature, simply by hammering; the joint is so strong that a seam can scarcely be seen. Such joints can easily be made by the workman on the ladder.—*Elek. Zeit.*, Nov. 1.

Grounding the Neutral of a Three-Wire System.—A brief article, in which the following advantages of grounding the neutral of large three-wire systems are discussed; it is never possible to get a shock between any wire and the ground of more than 110 volts; the risk of blowing neutral fuses is also reduced, which is shown in diagrams. In small systems, however, which can easily be kept clear of grounds, and where grounds can be promptly located by means of a ground detector, it is not advisable to permanently ground the neutral.—*Am. Elec.*, Nov.

REFERENCES.

Faults in Cables.—WRIGHT.—A reprint of the English article, abstracted in the Digest Nov. 3.—*Elec. Rev.*, Nov. 7.

ELECTRO-PHYSICS AND MAGNETISM.

Harmonics in Alternating Currents.—CLAUDE.—A French Academy paper in which he proposes to eliminate the harmonics, superimposed upon the sinusoidal curve, by the use of suitable condensers. If an alternator of given resistance and inductance is branched with a circuit having an inductance, a resistance, and a capacity, any given harmonic may be reduced to any desired extent by giving a certain small value to the resistance in the branch circuit. The resonating circuit practically affects only the harmonic it is intended to neutralize, and leaves untouched the fundamental sinusoidal curve. A special resonating circuit is required for each harmonic.—*Comptes Rendus*, Oct. 15; abstracted in Lond. *Elec.*, Nov. 2.

Neutral Point of Thermo Couples.—ABT.—A description of a simple method of determining the neutral point in thermo couples, specially suited to demonstration purposes. The neutral point is 117 degs. in a brass-lead couple, 276.8 degs. in an iron-silver couple, and 232 degs. in an iron-zinc couple.—*Ann. der Physik*, Nov. 10; abstracted in Lond. *Elec.*, Nov. 2.

Atmospheric Potential During a Solar Eclipse.—ELSTER.—An account of observations made near the town of Algiers, within the area of totality. He found a steady and decided diminution of the positive potential from 177 volts at 12:30 p. m. to 113 at 4:33 p. m., i. e., four minutes after totality; at 5:47 p. m. the original potential was nearly attained. He inclines to the opinion that during the eclipse

masses of air were aspirated from the sea which had different electric charges. (See also the results obtained by Oddone at Pavia, Digest, Oct. 27.)—*Alem. Soc. Spettroscopisti Ital.*, 29, 1900; abstracted in Lond. *Elec.*, Nov. 2.

Loss of Charge by Evaporation.—Henderson.—An account of experiments made to determine whether a liquid, when electrified, loses any portion of its charge by evaporation. Pellat has answered this question in the affirmative and draws conclusions regarding the electrification of the atmosphere. The present author first used water, negatively charged, as the liquid to be evaporated, and at the ordinary temperature of the room. He made further experiments with water heated up to the boiling point, thus ensuring rapid evaporation. Finally he used ether as the liquid to be evaporated. His result is in opposition to that of Pellat's, as he did not find a loss of charge from the liquid by evaporation.—*Phil. Mag.*, Nov.

Becquerel Rays.—Maier.—A description of a particularly active radium preparation obtained by Giesel, which shows a clear white spontaneous luminescence. The substance has shown no measurable diminution of radio-activity in the last eight months. He found that the magnetic deflection of the rays is very sensibly diminished by placing the substance in a vacuum. Efforts to obtain evidence of refraction and regular reflection failed. No diffraction was observed. Equally unsuccessful was the attempt to produce polarization by means of tourmaline. But all bodies appear to produce diffused reflection of Becquerel rays, and some bodies, like ebonite, aluminum, lead and iron, acquire a secondary radio-activity on prolonged exposure, which disappears, however, in a short time.—*Phys. Zeit.*, Oct. 20; abstracted in Lond. *Elec.*, Nov. 2.

Coherer.—Mizuno.—An account of a series of experiments on the action of the coherer, the chief results of which are as follows: He studied the successive changes of the resistance of the coherer accompanying successive oscillating sparks of the Hertzian vibrator. In platinum, lead, nickel, aluminum, cadmium, copper, silver, steel and potassium coherers the action of electric waves is to reduce their resistance at first to a large extent, and then less rapidly and with some intermediate rising and falling until the resistances assume certain final values. In iron, tin, bismuth, zinc and antimony coherers the resistances are diminished at first, but soon afterwards the changes become very irregular. With the iron coherer the action is conspicuously irregular. With small lead ball coherers the resistance attains its final value very rapidly, so that the successive stages of their histories present nothing conspicuous. He also studied coherers of alloys and of mixed metals. He thinks that the action of the coherer might be due to something like a welding.—*Phil. Mag.*, November.

REFERENCES.

Theory of Electromagnetic Waves.—Heaviside.—Continuations of his serial forming a part of the third volume of his work (Digest Aug. 4).—Lond. *Elec.*, Aug. 17, Oct. 5, Nov. 2.

Alternating Currents.—Goldsborough.—A continuation of his illustrated serial on "The theory of alternating dynamo-electric mechanisms." He gives an analytical proof of the rule for adding two sine functions of equal period but different phase and amplitude, by geometrically adding the vectors representing them. He further explains the terms fundamental wave and harmonics, and shows why no even harmonics can be expected in waves of e. m. f. or current developed in any practical alternating current circuit.—*Elec. Rev.*, Nov. 7.

Cathode Rays.—Villard.—A long abstract of a lecture on cathode rays, delivered before the Internat. Elec. Congress. He discusses the electric resistance of discharge tubes, the phenomena of phosphorescence, the electrostatic deviation of cathode rays, the electric and magnetic dispersion, the passage of the rays through metallic sheets, non-deviable rays, and the nature of the radiant matter.—*Sc. Amer.*, Nov. 10.

Industrial Electromagnets.—Guenee.—An illustrated article in which he gives the theory and description of an industrial electromagnet, shown at the Exposition. The reluctance can be varied, as the middle part consists of a column of iron disks on a non-magnetic axle, which can be pressed together at will.—*L'Ind. Elec.*, Oct. 10.

Electro-Chemistry and Batteries.

Secondary Electrolytic Action.—Brochet.—An account of an investigation of the disagreement between theory and practice in the electrolysis of a concentrated solution of "hypo." The quantity which disappears does not correspond to that calculated from the transformation of the hypochlorite into chloride at the cathode, and of the formation of chlorate at the anode; too much hypochlorite disappears and too much chlorate appears; the amount of error often attaining over 25 per cent and increasing with the concentration of the salt. He accounts for this as follows: The immediate neighborhood of the anode is always acid; hence, besides the hypochlorous acid transformed into chloric acid by the current, some of the highly concentrated acid undergoes spontaneous oxidation. The secondary electrolytic action is the reason why no hypo solution can be effectively electrolyzed with a concentration amounting to more than 12.7 grammes of active chlorine per liter.—*Comptes Rendus*, Oct. 15; abstracted in Lond. *Elec.*, Nov. 2.

Commercial Electrolysis of Water.—Buffa.—A long abstract of a paper, in which he first discusses the difficulties of the commercial electrolysis of water. To prevent the mixture of the oxygen and hydrogen given off at the electrodes, a diaphragm is necessary, which, however, increases the internal resistance and diminishes the efficiency. He recommends using metallic septa, which he claims will act "as intermediate electrodes. The drop of voltage from the anode to one side of the septum is insufficient to decompose water and the drop of voltage from the other side of the septum to the cathode is likewise insufficient. Therefore no liberation of the products of electrolysis occurs at either surface of the metallic septum, but is confined to the electrodes proper." (This is either poorly described or obviously wrong.) Iron electrodes in an alkaline bath are most convenient; caustic soda is preferable to caustic potash on account of its cheapness; it is used as a 14 per cent solution. A difficulty in working may be caused by the deposition of a layer of alkaline carbonate on the electrodes due to the absorption of carbonic acid gas from the air, which is avoided by covering the aqueous liquid with a film of mineral oil. The practical uses to which the gases obtained by the electrolysis of water may be applied, are briefly discussed.—Lond. *Elec.*, Nov. 2.

Concentration Variations at the Electrodes in Electrolysis.—Sand. An abstract of a Brit. Phys. Soc'y paper on "The concentration at the electrodes in a solution, with special reference to the liberation of hydrogen by electrolysis of a mixture of copper sulphate and sulphuric acid." He develops a formula for calculating the concentration at the electrode of a solution of a single salt, from which the metal is being deposited under the conditions that the solution is contained in a cylindrical vessel bounded by the electrodes, that no convection currents occur, and that the diffusion of the salt obeys Fick's laws and its transport values are constant. In the case of mixtures it is possible to arrive at limits for the concentration.—Lond. *Elec. Elec. Rev., Elec. Eng.*, Nov. 2.

Freezing Point Depressions for Electrolytes.—MacGregor.—A diagrammatic study of the freezing point depressions for electrolytes, giving the following results: "The curves of equivalent depression against ionization-coefficient have positions, forms and slopes such as they might be expected to have on reasonable assumptions as to the mode of ionization and constitution in solution, according to the Van't Hoff-Arrhenius theory of the depression of the freezing point in solutions of electrolytes." They are consistent with the depression constant having a common value of about 1.85 for all the electrolytes examined.—*Phil. Mag.*, November.

Dry Cell.—A brief note on a dry cell, made by a German company and recently exhibited before the Electrotechnical Society of Frankfort. The manganese is replaced by calomel. It is said to be very constant. With equal capacity it requires a much smaller space than the manganese cell. It is, however, somewhat expensive.—*Elek. Zeit.*, Nov. 1.

REFERENCES.

Permanganic Acid by Electrolysis.—Morse and Olsen.—In order to obtain manganese dioxide entirely free from potassium and other impurities, they have devised an apparatus by which they can electrolyze potassium permanganate and obtain pure permanganic acid.—*Am. Chem. Jour.*, v. 23, p. 431; abstracted in *Technol. Quart.*, September.

Salmiac Calcidum.—A note on the use of "salmiac calcidum" in galvanic cells, and a diagram showing the decrease of voltage for constant resistance with salmiac calcidum and with an ordinary salammonic solution; the former behaves decidedly better. The composition of that salt is kept secret.—*Elek. Anz.*, Oct. 4.

Electrolytic Production of Soda and Chlorine.—Hobart.—The conclusion of his illustrated serial, in which he describes the Mercer system.—*Am. Elec.*, November.

UNITS, MEASUREMENTS AND INSTRUMENTS.

REFERENCES.

Insulation Resistance Tests.—WRIGHT.—A reprint of his article, abstracted in the Digest Nov. 17.—*El'ty*, Nov. 14.

Precision Bridges.—EDELMANN.—An illustrated article giving some remarks on the testing of Wheatstone bridges for precise measurements.—*Elek. Zeit.*, Nov. 1.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Lines.—An editorial giving a summary of the proposals which have been made to increase the efficiency of long-distance telephone lines. The proposals of Thompson, Stone, Heaviside and Pupin, all of which tend to an increase of the inductance of the line, are briefly discussed. It is not doubted that the theory upon which these proposals are based is correct in general, but the degree of the success cannot yet be stated. If a cable is constructed according to one of the proposals of Thompson or Pupin, and if it fails, then the cable will neither be practical for telephony, nor will it be more than an inferior telegraph cable. Proposals for a practical test must give at least the assurance that the cable will at least be a good telegraph cable. It is said that the aim should be therefore to obtain a smaller resistance, a smaller capacity and less leakage, and that in this respect progress has been made recently by the Rheydt cable works which manufacture "a cable core with very great air-space insulation." In order to prevent disturbances due to contacts of overhead lines, Hackethal recently suggested using insulated instead of bare wires for overhead lines, the wire being covered with a cheap fibre material, impregnated with a mixture of red lead and linseed oil, which becomes hard in the air; one insulator is sufficient for the two wires of a double line; the disadvantages are that the capacity is increased and that the insulation will certainly not last forever, so that after some years the entire line must be renewed.—*Elek. Zeit.*, Nov. 1.

REFERENCES.

Wireless Telegraphy.—BLONDEL and FERRIE.—A translation in abstract of their Internat. Elec. Cong. paper on the present state of wireless telegraphy by Hertzian waves (Digest, Nov. 17).—*West. Elec.*, Nov. 10. The abstract from the Lond. *Elec.* is reprinted in *El'ty*, Nov. 14.

Interior Telephone Systems.—HENRY.—A continuation of his illustrated serial, in which he continues the description of intercommunicating systems.—*Am. Elec.*, November.

MISCELLANEOUS.

REFERENCES.

Porcelain.—HERZOG and FELDMANN.—A very long illustrated article on the manufacture of porcelain for electrical purposes. They discuss at some length the material and its properties, the different methods of manufacturing the forms and the manufacture and burning of the china ware.—*Elek. Zeit.*, Nov. 1.

Electric Furnace.—KELLER.—A long abstract of his Internat. Elec. Congress paper on the development of the electric furnace, which was more briefly abstracted in the ELEC. WORLD AND ENG. Sept. 15, p. 412.—*Eng. and Min. Jour.*, Nov. 10.

Paris Exposition.—An illustrated description of some machine exhibits in the French, Holland and Austrian sections.—*Am. Elec.* November.

An illustrated description of the machine exhibit of the Helios Company, of Cologne.—*Zeit. fuer Beleucht.*, Oct. 10.

Illustrated descriptions of a 1000-hp single-cylinder steam engine of Weyer & Richemond, driving a 560-kw direct current dynamo of the Cie Générale d'Electricité de Creil at 110 revolutions; also of generators and transformers, exhibited by the Oerlikon Company.—*Zeit. fuer Beleucht.*, Oct. 20.

New Book.

GALVANIZING AND TINNING. A Practical Treatise on Coating with Tin and Zinc, with a Special Chapter on Tinning Gray Iron Castings. By W. T. Flanders. David Williams Company: 93 pages, 40 illustrations. Cloth. Price, $2.

There are many of our readers in the industrial field to whom a knowledge of the details treated in this book will be of interest and value. It is direct and explicit in its information and instruction and is clearly illustrated with many diagrams.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Next meeting, New York and Chicago, Friday, Nov. 23. For titles of papers see announcement in Current News and Notes.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Next meeting, 12 West Thirty-first Street, New York, Dec. 4-7.

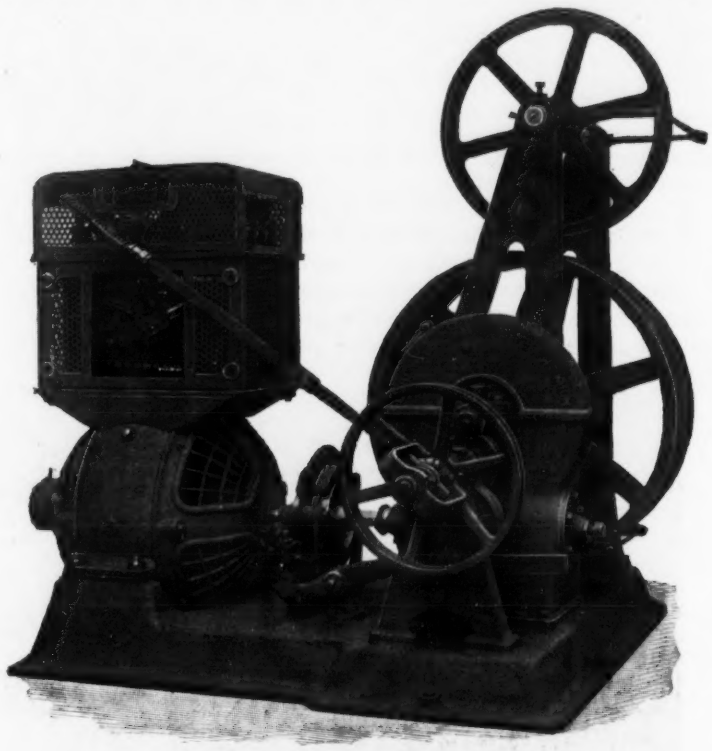
CHICAGO ELECTRICAL ASSOCIATION. Next meeting, Dec. 7. Paper by C. Wirt.

LEAGUE OF AMERICAN MUNICIPALITIES. Next meeting, Charleston, S. C., Dec. 12-15.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting Ottawa, Ont., 1901.

Direct Connected Elevator Equipment.

The accompanying illustration shows a new direct connected elevator equipment made up of motor and controller built by the Three Rivers Electric Company, of Three Rivers, Mich., and the elevator by the Gardner Elevator Company, of Detroit. The combination of these principal parts has been made with great care, and the completed apparatus has run so well in actual service that steps are being taken to bring out a full line of sizes for every sort of freight and high-speed elevator work.



DIRECT CONNECTED ELEVATOR.

The motor is the Three Rivers standard E type frame, with brackets for supporting it on the elevator base, and is carefully insulated therefrom. The field and armature windings are made with regard to the hard work they must do to meet existing requirements, and no pains have been spared to make the insulation ample beyond the possibility of a breakdown. The fields are either simple shunt or compound wound to suit conditions, and the correct number of turns in the latter case have been determined by tests for the highest efficiency at different loads and speeds.

The controller, originally designed by Mr. Geo. F. Card for the Card Electric Company, of Mansfield, Ohio, has been remodeled throughout and contains many new improvements. By mounting it on the motor, space is saved, and all connections to the motor are made within the case. No wires are exposed except the main leads. All parts of the controller are made interchangeable, and the best material is used throughout.

All connections between the motor controller and hoist are made in a direct and substantial manner. The means for operating the reversing switch is simple and absolutely positive. The brake is powerful; the automatic device simple and reliable, and the hoisting mechanism of the highest efficiency.

Interurban Electric Railways.

Speaking of the extension of the interurban electric railway recently, the president of a Western steam railroad said: "As a matter of fact we do not feel that the electric interurban road is inimical to the interests of the steam railroad. So far as we are concerned, we welcome the construction of new electric roads connecting the towns through which our lines run. It is true that we lose of course considerable local passenger traffic, but on the other hand these increased facilities for travel induce a number of people to live in these various towns who might otherwise be crowded into one city. The result of this is that there are more stores in these towns, and all these stores naturally have their supplies brought to them over our road, so that our freight receipts are thus increased to a much larger extent than our local passenger traffic is decreased by the competition of the electric interurban road."

This is a somewhat different view from that held by so many people who think that the electric railway is rapidly supplanting the steam railroad for interurban work. It would seem rather to be supplementing than supplanting it, and there is now, and probably will be for many years to come, a field for both the steam and electric roads. For comparatively short passenger hauls the steam railroad cannot expect to successfully compete with the electrical; but the steam railroad will naturally continue to carry the freight until such time may arrive when the electric railroads will build special tracks to run their freight service over, as it is not practicable to run freight and light passenger traffic over the same tracks for city aud suburban services.

Automobile Show at Grand Central Palace, New York.

Following closely upon the show at Madison Square Garden came another automobile show at Grand Central Palace from Nov. 14 to 24, with the veteran Mr. Marcus Nathan as manager. Holding two similar exhibitions so close together might be regarded as risky, but the idea is that as so many people are in New York for Horse Show week there would be a natural overflow to the Palace of those interested in the new art and desirous of seeing the vehicles. Be this as it may, the fact that two such shows, well supported by the public and the trade, can be held in one city a few days apart, testifies to the activity and vitality of the new industry.

The show occupies the main floor of the big Palace Building, the vehicles being grouped chiefly under the galleries or in the front hall. The large central space is employed for track purposes, being railed off and boarded, all the planking being screwed down, so that not a nail projects. Within the circular track, itself 20 ft. in width, is a large space into which vehicles can run and go through evolutions, so that the effect is virtually that of a two-ring circus, put together and both going at once.

On the main floor, under the galleries, electric vehicles are the chief feature and are very much in evidence. The American Electric Vehicle Company, which was not on view in the Garden, has here a splendid exhibit of 16 electric automobiles in all the classes—stanhope, runabout, brake, etc.—many of the types having already been illustrated and described in these pages. In the motor a hollow armature shaft is used, through which the driving shaft passes, terminating in differential gears, a solid rear axle being retained. The battery used has a large output per pound of element and has shown considerable endurance. The controller gives five speeds up to 17 miles an hour. A band-brake is used, and the steering head is handy and neat.

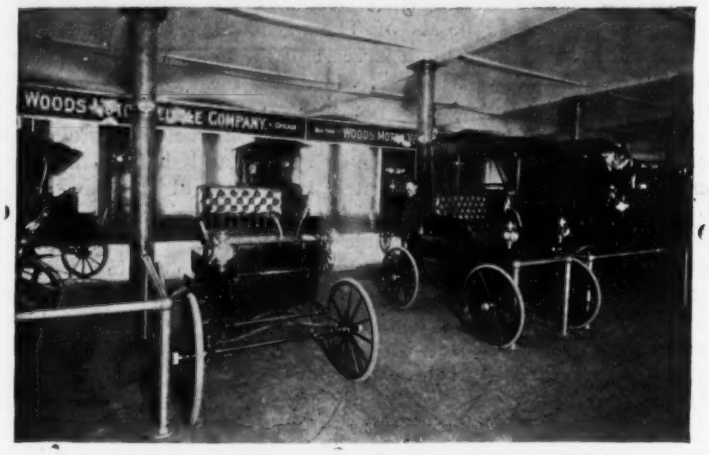


FIG. 2.—THE WOODS EXHIBIT.

The Electric Vehicle Company has the largest and most imposing exhibit of its Columbias, no fewer than 20 being grouped in the space, to say nothing of those exercising in the arena or used for trial on the streets adjacent with intending customers. In general lines the exhibit conforms to that made at the Garden, although with a view to the tastes of Horse Show patrons prominence is given to a number of remarkably fine private automobiles. They are practically all electric, with a mileage capacity from 25 to 85 miles on one charge, and speeds from 12 up to 24 miles an hour. An exception may be noted in the gasolene types of runabout, jaunting car, etc. The gasolene tricycle will carry 500 lbs. and a driver, and has gasolene supply for 75 miles, with water for 20 miles.

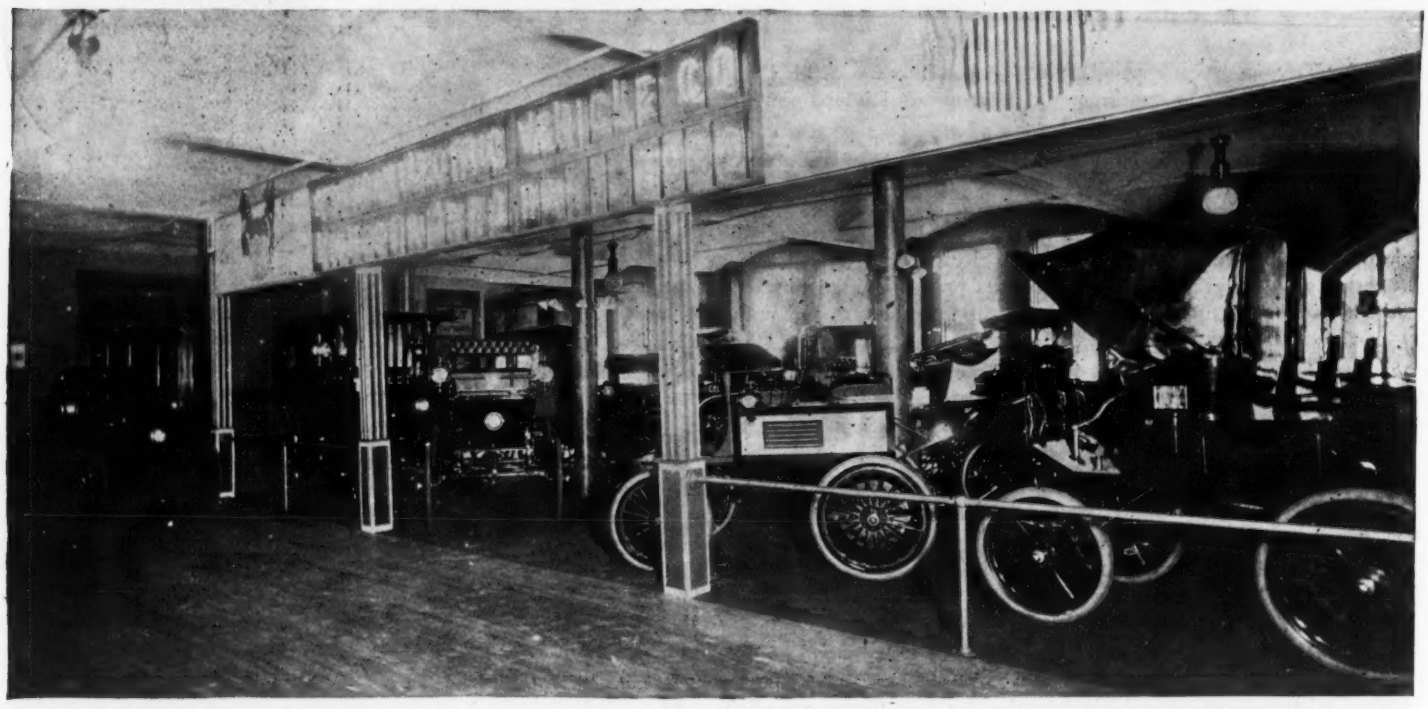


FIG. 1.—EXHIBIT OF AMERICAN ELECTRIC VEHICLE COMPANY, GRAND CENTRAL PALACE, NEW YORK.

THE WOODS MOTOR VEHICLE COMPANY has a neat exhibit of 10 of its electric automobiles, of the types noted recently in our description of its Garden exhibit. Its hansom is shown below exercising on the track.

Exhibits of their electric automobiles are made also by the Buffalo

FIG. 3.—EXERCISING ON THE TRACK.

Electric Carriage Company and Strong & Rogers, of Cleveland, both of whom exhibit a handsome stanhope.

One of the novelties is the runabout shown by the Tripler Liquid Air Company, which, it is stated, will be shown in operation this week. It is said that on one charge of liquid air the vehicle will run a distance of 60 miles and can be made to develop a speed of 50 miles an hour. Any pressure desired from 10 to 300 lbs. can be obtained immediately after charging the automobile and can be maintained by simply setting a couple of valves at the proper points. The company states that there have been great difficulties in controlling the air, but that it can now retain a charge in the vehicle for eight to ten days.

An interesting exhibit is shown by the Dayton Electrical Manufacturing Company, of Dayton, Ohio, of its Apple igniters, which have from time to time been noted in our pages. These pretty little generators are most satisfactory in a field where great trouble has been experienced. They are fitted with governors, so that all engines, the flywheels of which are turned in starting at a rim speed of, say, 3800 ft. a minute, can be started direct from the dynamo; and as the speed of the engine increases the governor will maintain the speed of the dynamo constant, no matter what the variation of engine speed may be. The "Ideal" outfit will furnish a good spark at any time, whether the engine is started by the first explosion or is turned by hand.

In the line of gasolene and steam vehicles, the exhibit of the De-Dion-Bouton Motorette Company may be noted; while there are also several neat exhibits of supplies and accessories.

One device which attracts no little attention is the electrant, shown in our issue of Nov. 10. It is built by the General Electric Company and is a device for charging the batteries of automobiles. It is intended to be connected to the mains of an Edison system, and when so connected is suitable for charging automobiles having battery potential of 80 volts. In it is included a Thomson recording wattmeter of the railway type, provided with contacts on the dial, so that when the prepaid amount of energy has been delivered, a circuit will be made and the main switch opened. Across the centre of the electrant, on the outside, are four plug receptacles, numbered 1, 2, 3 and 4, from the left. The resistances in series with these receptacles are so proportioned that 20, 30, 40 and 50 amperes will flow when charging an 80-volt battery from 110-volt circuit. When an automobile requires a charge, the plug carried by the automobile is inserted in any one of the receptacles. Upon turning the handle of the door, just above the receptacle, a contact is closed and current flows from the battery of the carriage through an electromagnet, in the electrant, and this magnet, attracting its armature, releases the catch on the door and allows it to be opened.

A coin may now be deposited in the slot in the apartment made accessible by opening the door, the switch handle turned down, and this motion is transmitted through the coin to an interior switch blade, closing the main circuit. The handle must now be returned to its initial position before the door can be closed. The closing of the door operates an auxiliary switch and current is fed into the battery. As long as the door remains open no current passes. When the prepaid amount of current has been withdrawn, a contact on the meter dial is closed and the main switch is thrown open, returning everything to its initial position as before the carriage arrived. The switch will also be thrown over provided the plug is withdrawn before the charge is completed, and any unconsumed portion of the prepaid energy reverts to the supply company. This may be avoided in order to change receptacles by pressing the contact button on the left, which prevents the closing of the contact through the release magnet.

FIG. 4.—EXHIBIT OF COLUMBIA ELECTRIC AUTOMOBILES.

Telephone Developments in Philadelphia.

Advices from Philadelphia state that interesting developments in the Philadelphia telephone situation are promised by the suit to be brought by the Clay Commercial Telephone Company against the city and the Keystone Telephone Company. It is said that the Clay

Company is the medium through which the Latta party, of the National Telephone Company and Telephone, Telegraph & Cable Company of America, in their plan to become a competitor of the Bell Company all over the country have sought to enter Philadelphia. The political contingent in Philadelphia, however, sought to exact $250,000 cash from the Latta people for permission to go ahead, and when this was denied and the project held back, they organized the Keystone Company, which the bill about to be filed alleges is a scheme to block off other companies. In 1884 the Clay Company had 1500 miles of wire and several hundred subscribers. It suspended operations because the city was enjoined from using telephones until the Bell patents expired in 1894. In 1899 it resumed operations in the line of raising capital, expended $250,000 in plant, has now $750,000 cash capital and is ready to go on with its business. For these reasons, it maintains that it has not forfeited its franchise contract and that the city had no right to take it away. A Minnesota Supreme Court decision is said to favor this contention. One million dollars damages will be claimed in the suit, but it is represented that the company would rather have the franchise.

Two Large Induction Coils.

During the past week Messrs. Queen & Co. had on exhibition at their New York store two large induction coils made by that firm on the order of the Japanese Government. The order was given to the firm last summer, and the finished apparatus is now ready for shipment to Japan, where the coils will be used in wireless telegraph experimental work. The contract called for coils capable of giving a spark one metre in length. At the final test of the coils they were found to more than fulfil the requirements, a spark of 45 ins. being readily obtainable between the secondary terminals. The construction of the coils is new and in many respects novel, the secondary of each being constructed in two parts, for the principal purpose of facilitating shipment, the total weight of each coil complete being 1500 lbs. The centre ends of the two sections are connected together and grounded to the primary winding. There is no hard rubber tube used for insulation between the secondary and primary, paper being

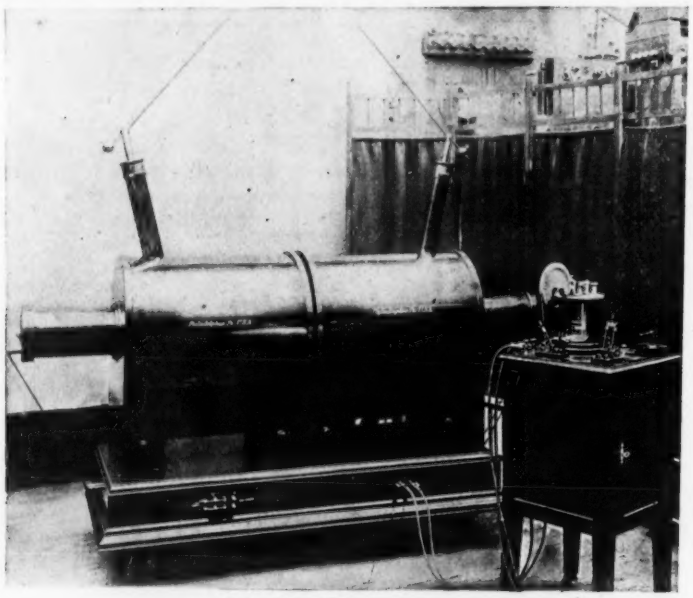


FIG. 1.—ONE OF THE INDUCTION COILS.

used instead. Owing to the great length of the core, special means were adopted to give stiffness to the bundle of wires—the core being 4 ins. in diameter. This strengthening was effected by using four angle irons placed back to back with one another at the centre, thus providing a rigid support for the core.

The cabinet at the right hand of the illustration contains the condenser, the switches for making the various connections, and the interrupter. In order to properly utilize the current which was necessary to operate these coils it was found necessary to devise a new form of interrupter. This is operated by means of a small motor inside of the cabinet, the speed of the motor being variable by means of a suitable rheostat. It is evident therefore that any number of interruptions per minute within reasonable limits is obtainable. Both the cabinet and the coil proper are mounted on casters and can be readily moved from place to place. The coil is mounted on a heavy mahogany stand, and the end pieces and supports are of the same wood. The induction coil proper is easily separable, the two halves of the secondary being held on the base by wooden pins.

The windings of the coil and the capacity of the condenser were so arranged that the instrument can be used either on a low or high voltage circuit. In order to secure the greatest spark length a potential of 40 volts at the terminals of the primary was found most suitable. At this potential a current of about 30 amperes would give a very

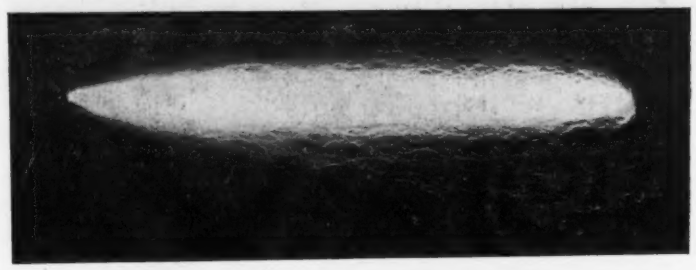
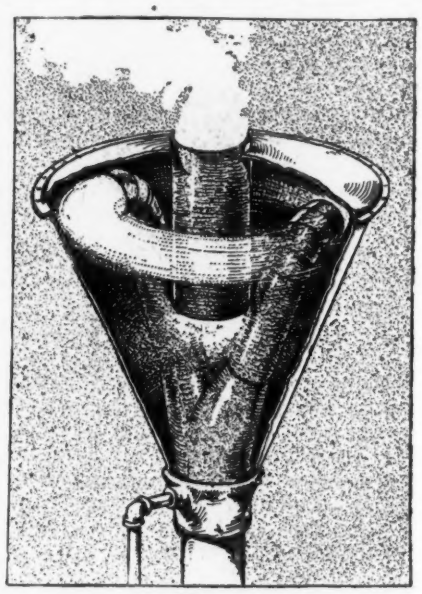


FIG. 2.—A SPARK.

heavy 42-in. spark with the interrupter running at approximately 3 interruptions per second. When the terminals are somewhat closer together, and the coil giving about a 32-in. spark, the number of interruptions per second can be greatly increased and a correspondingly smaller amount of current used. Fig. 1 shows the coil when producing a spark approximately 32 ins. in length, with the interrupter running at about 20 breaks per second. Fig. 2 shows one of the sparks.

The Sturtevant Exhaust Head.

An interesting example of the practical application of centrifugal force is presented in the design of the Sturtevant exhaust head. The accompanying illustration serves not only to show its construction, but also its method of operation. The head is an inverted cone of heavy galvanized steel plate attached to the end of the exhaust pipe. Its interior construction consists of two branching pipes extending upward from and connected to the exhaust pipe. These individual pipes, which are parallel to the sides of the casing, terminate in elbows, from which the steam escapes. Its contact with the circular sides of the case gives it a whirling motion, which thus gives centrifugal force an opportunity to act. Inasmuch as this force is proportional to the weight of the substance acted upon, and as water weighs about 1600 times as much as exhaust steam, the natural result is that the water contained in the steam is thrown outwardly radially with great force. Striking upon the sides of the cone it trickles to the bottom and there escapes through the drip pipe. Such oil as may be entrained with the steam is likewise separated.



EXHAUST HEAD.

The steam, now dry, is forced downward by the additional entering volumes and quietly escapes to the atmosphere through the central pipe. It is evident that all tendency on the part of the water to escape with the steam is overcome by the centrifugal action.

The central pipe being made larger than the supply beneath, and the cold sides of the case tending to condense a portion of the steam, it is manifest that no back pressure can be exerted upon the engine. The absence of baffle plates and the absolute simplicity of design are the best guarantees of endurance on the part of this head. It is built by the B. F. Sturtevant Company, Boston, Mass., in sizes ranging from 1 in. up to 36-in size of exhaust pipe.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The rush for stocks which was so prominent a feature of the market during election week subsided considerably last week, the reaction being followed by a hardening of rates for money. On Monday the transactions on the New York exchange were 1,700,000 shares, an unprecedented figure. The largest losses of the week were in the industrials, but in no case was there any serious drop. One of the features, and perhaps the main feature, was General Electric. The demand for this stock was due to the statement of the company's financial condition, published in connection with the petition to the New York Stock Exchange, for the listing of $4,500,000 additional common stock. The stock, which closed the week previous at 148, rose to 170 at one time, and closed at 165½—a net gain of 17½ points for the week. The number of shares sold was 20,600. The other electrical and electric railway securities closed at advanced quotations, the net gains being as follows: Brooklyn Rapid Transit, 2 (sales 184,035 shares); Metropolitan Street Railway, 2¾ (sales 30,090 shares), and Western Union, 2 points (sales 12,706). In outside securities the market was somewhat complicated, and prices were irregular, although the general tendency was upward. Copper stocks were the most active, Amalgamated copper being the leading stock of the group in point of activity. Some of the industrials were in good demand, while in transportation stocks less activity prevailed, and none of this class showed much improvement. Money on call during the week ranged between 2 and 6 per cent, the average being about 3 per cent. Time money was freely offered, the rates being 4½@5 per cent for 60 days to six months. Mercantile paper was moderately active. Rates were 4@4½ per cent for endorsed bills receivable to run 60 to 90 days; 4½@5 per cent for high grade single names, four to six months, and 5@6 for others not so well known. Following are the closing quotations in the four cities named:

NEW YORK.

	Nov. 10.	Nov. 17.		Nov. 10.	Nov. 17.
Gen. Elec	148	165½	Elec. Veh	19	20
Bklyn Rap. Tran	68¾	70¾	Elec. Veh., pfd	40	45
Met. St. Ry	167¾	170¾	Gen. Car	4¾	5
Am. Tel & C	92	91	Ill. Elec. Veh. Tran	1	1¼
West. Un. Tel	84	86	N. Y. Elec. Veh. Tran.	7¼	7
Am. Dist. Tel	—	34	N. E. Elec. Veh. Tran.	3¾	3¾
Com. Cable	—	170	Tel. & Tel. Co. of Am.	5	5
Elec. Boat	20	17	Hud. Riv. Tel	116	116
Elec. Boat, pfd	41	41	N. Y. & N. J. Tel	150	150

BOSTON.

	Nov. 10.	Nov. 17.		Nov. 10.	Nov. 17.
New Eng. Tel	126	—	Erie Tel	102	105
Mex. Tel	—	3	Gen. Elec., pfd	140	141
Westing. Elec	—	*52½	Am. Tel. & Tel	153	155½
Westing. Elec., pfd	64½	—	Ed. Elec. Lt	—	—

PHILADELPHIA.

	Nov. 10.	Nov. 17.		Nov. 10.	Nov. 17.
Elec. Stor. Bat	81	83	Phil. Elec	3	3⅛
Elec. Stor. Bat., pfd	83½	83	Pa. Elec. Veh	4	4
Elec. Co. of Am	10¾	10¾	Pa. Elec. Veh., pfd	*2	*2
Gen. Elec. Auto	¼	¼	Am. Rys	36½	38½

CHICAGO.

	Nov. 10.	Nov. 17.		Nov. 10.	Nov. 17.
Chicago Edison	139	142	Chicago Telep. Co	210	215
Chic. City Ry	250	255	Union Traction	12	14¼
Nat'l Carbon	16¾	17	Union Traction, pfd	51	54½
Nat'l Carbon, pfd	82½	82	Northwest Elev. Com	30	29½

*Asked.

BALTIMORE TELEPHONE DEAL.—It is said, and denied, that negotiations are being conducted looking to the absorption of the Maryland Telephone Co. of this city, the Pittsburg & Allegheny Telephone & Telegraph Company, of Pittsburg, Pa., and the Delmarvia Telephone Company, of Wilmington, Del., by the Erie Telegraph & Telephone Company. The three former corporations are controlled by a Baltimore syndicate. The deal, it is understood, is being arranged by Alexander Brown & Sons and George R. Webb, president of the Maryland Telephone & Telegraph Company. Mr. Webb is out of the city, and Alexander Brown refused to make a statement. The Maryland Company is capitalized at $1,000,000, with $1,000,000 of 5 per cent bonds. The Pittsburg & Allegheny Company has $1,500,000 of stock and $1,200,000 of 5 per cent bonds. The Erie Telephone & Telegraph Company is incorporated under the laws of New York, but is controlled by New England people, the main office being in Lowell, Mass. The Pittsburg exchange was described and illustrated in the ELECTRICAL WORLD AND ENGINEER of Nov. 3 by Mr. Kempster B. Miller.

GENERAL ELECTRIC.—Last week the New York Stock Exchange governors admitted to the trading list $4,415,000 General Electric common stock. The business of General Electric for the nine months ended Oct. 31, 1900, has been, it is said, at the rate of $2,500,000 per month against an average for the previous year of $1,800,000 per month in the previous fiscal year. At this rate the gross business of the year will be $30,000,000. The net profits from all sources, on this business, should be $6,000,000 for the year after very liberal charges to plant, patents, etc. The company has in banks and trust companies cash on deposit in excess of $4,000,000. The stock above listed is to be added from time to time to the amount now on the list, as and when official notification is given that said stock has been issued in exchange for debenture bonds, the amount of common stock not to exceed in the aggregate $22,691,000.

GENERAL CARRIAGE has been actively and at an advance traded in, largely due to purchases by insiders, which were accompanied by the announcement that the General Carriage Company had made arrangements with the Westcott Express Company whereby the General Carriage Company will soon establish a cab service at the Grand Central Station and elsewhere in this city where cabs are now stationed by the Westcott Express Company. On what terms the arrangement was made was not announced, and so it is difficult to decide what profit the General Carriage Company may expect from the arrangements which have just been made. It is stated, however, that the company is making a fair profit from the operation of 75 cabs or thereabout which it already has in service.

THE CENTRAL UNION TELEPHONE COMPANY is to absorb the Iowa Telephone Company, which was formed about three years ago by taking over the business of the Central Union in that state and consolidating it with that of another concern. Thus the present move is only the readjustment of a relationship which has long existed. While most of the stock of the Iowa Company is held by the Central Union, there are some outside holdings which will be exchanged for Central Union shares, thus involving a small increase—about $100,000—in the amount of Central Union stock outstanding.

DIVIDENDS.—The Niles-Bement-Pond Company has declared the regularly quarterly dividend of 1½ per cent on its preferred stock, payable Nov. 24. The Barney & Smith Car Company has declared a quarterly dividend of 2 per cent, payable Dec. 1. The work completed for seven months and the work on the books for five months indicate earnings of five million dollars for fiscal year. The Wayne (Pa.) Electric Light Company has declared a dividend of 3 per cent, payable Dec. 1, making 6½ per cent for the year.

WESTERN ELECTRIC BOND ISSUE.—The Western Electric Company has executed a trust deed to the Chicago Title & Trust Company upon 225,000 sq. ft. of land at West Polk Street and the river to secure a bond issue of $500,000, payable in five years and bearing 4½ per cent interest. The purchase of this property was noted recently in this department.

Commercial Intelligence.

THE WEEK IN TRADE.—The reports received during the past week as to trade and business conditions indicate a general feeling of buoyancy and increasing activity. Business is stimulated by the settlement of the questions involved in the election and by the seasonably cold weather. Touching the general situation, Dun's *Review* says there is not one of the great industries in which contracts delayed until after election are not being closed daily, with confidence that in trade generally a great structure is to be built on the foundation laid in the last few years. Prices of commodities advance almost without exception, and all the changes in manufactured goods are in the direction of firmer quotations. The smallness of stocks of goods carried is a feature of the reports from most of the leading centres. Scarcity of labor gives manufacturers in the Middle States great concern. Activity at iron and steel mills steadily increases, and there is an equally uniform advance in quotations. Orders come forward in the best volume since last spring, when there was severe inflation of prices, and requests for quick delivery are general. The railways are free buyers of cars and other material, and structural material tends upward. The failures for the week, as reported by Bradstreet's, numbered 227, as against 161 the week previous, 199 in the corresponding week last year, 229 in 1898, 235 in 1897 and 308 in 1896. October export trade returns, Bradstreet's states, constitute perhaps the most striking chapter in the marvelous export trade history of this country in recent years. While cotton exports are responsible for much of the gain, increased shipments of manufactured goods are indicated. Further details of the October export trade are given elsewhere in this department. The copper market was steady and unchanged at 17c. per lb. for Lake and 16⅝c@16¾c. for electrolytic.

Mr. John Stanton, the statistician, says that the copper situation is strong and will probably continue so for some time longer.

LONDON UNDERGROUND.—The next big thing in London is the electrical equipment of the Metropolitan Underground now run by steam. It is stated from London the cost will be $25,000,000. American bids are coming from the Westinghouse, General Electric and Thomson-Houston companies. The British competitors include Mather & Platt, the Brush Electric Company, Crompton & Company, Thomas Parker & Company and Dick, Kerr & Company. Germany is represented by the Allgemeine Electricitaet Gesellschaft, Siemens Bros., Schuckert & Company and Felten & Guilleaume, while the Breguet Electrique Company and MM. Hutin & Leblanc will attempt to secure the order for France. In an interview Sir William Preece, consulting engineer of the Metropolitan District Railway, said: "Owing to the fact that we have not hampered the bidders with specifications of any kind, we expect to be tendered a scheme for the best system of electric traction which modern ingenuity is capable of devising. We possess facilities for a service of 22 trains an hour, and all we ask is a plan of operation which will test our capacity to the utmost. That the United States will be prominently represented goes without saying. That country is the pioneer of all that is good and great in electrical science, and in the application of it she is not to be surpassed."

EXPORTS OF ELECTRIC MATERIAL.—The following were the exports of electric material from the port of New York for the week just ended: Antwerp—32 cases electric material, $3,986. Argentine Republic—45 packages electric material, $2,585. British Guiana—274 packages electric material, $2,902. British West Indies—13 packages electric material, $340. British Australia—164 packages electric material, $3,831; 37 cases electric machinery, $10,355. Bremen—7 cases electric material, $469. British Possessions in Africa—246 cases electric material, $11,104; 18 cases electric material, $3,598. Cuba—9 packages electric material, $180; 186 packages electric railway material, $15,448. Central America—14 packages electric material, $462; 41 packages electric material, $1,934. Dunkirk—12 packages electric material, $4,157. Fiume—1 case electric machinery, $22. Glasgow—196 packages electric material, $53,776; 29 electric cable reels, $13,720; 3 cases electric machinery, $372. Havre—89 packages electric material, $4,984. Hamburg—70 packages electric material, $3,843. London—210 cases electric machinery, $5,006; 81 packages electric material, $7,389. Liverpool—91 packages electric material, $5,868; 42 packages electric material, $1,110. Mexico—190 packages electric material, $239; 3 cases electric machinery, $642.

OCTOBER EXPORTS have broken all monthly records in the history of the commerce of the United States, and the 10 months of 1900 ending with October also break the record of exports for the corresponding period of preceding years and give the assurance that the calendar year 1900 will show the largest exports in the history of our foreign commerce. The total exports during the month of October, as shown by the records of the Treasury Bureau of Statistics, were $163,093,597. The total for 10 months ending with October, 1900, is $1,194,775,205, or practically double that of the 10 months ending with October, 1894. Exports exceeded imports during the 10 months ending with October by $499,667,936; while in the corresponding 10 months of 1894 imports exceeded exports by $96,663,369. The year 1900 will for the first time in the history of our commerce show an export of more than $100,000,000 value in every month of the year, while for the first time a single month—October, 1900—passes the $150,000,000-line, being, as already stated, $163,093,597, against the highest preceding record of $134,157,225, which was made in March, 1900. Manufactures are $60,000,000 more than in the corresponding nine months of 1899.

A BIG BATTERY CONTRACT.—The Baltimore & Ohio Railroad Company has placed with the Electric Storage Battery Company an order for batteries which will give an output of 1200 horse-power and which are intended to assist in the supply of current to the electric locomotives through the belt tunnel. The contract was placed through Mr. R. C. Hull, of the Storage Battery Company's Baltimore office. The building for the battery will be 145 ft. long by 44 ft. wide, and the equipment will consist of 320 cells of 39 plates each. Each cell complete will weigh about 1800 lbs. It is interesting and proper to note that just such an equipment as this was strongly advocated in the *Electrical Engineer* by Mr. R. Macrae as far back as June, 1892. At that time, however, few people had any faith in storage batteries for any kind of work.

THE JOHNSTOWN TELEPHONE COMPANY, of Johnstown, Pa., has awarded the contract for a 1500-line multiple switchboard to the Kellogg Switchboard & Supply Company, of Chicago. This switchboard will be equipped with self-restoring drop line signals and the lamp double supervisory system, and will operate on the central battery system. Among other smaller contracts recently secured by this company are those at Elmore, Ohio, 100 lines; Woodville, Ohio, 100 lines; Huron, Ohio, 100 lines; Waupaca, Wis., 150 lines; Thomas, W. Va., 50 lines, and Sapulpa, I. T., 100 lines. These exchanges will be equipped with the Kellogg "Express" 150-line switchboard. At Bloomfield, Ind., a small size special "Universal" switchboard will be installed, having 150 lines equipped and a capacity of 400 lines.

STORAGE BATTERY EQUIPMENT.—Messrs. A. A. & F. Piatt, Lansing, Mich., have closed a $40,000 contract for lighting the Downing House block and for its steam heating. Mr. A. A. Piatt also runs the electric power business and supplies the street railway company with current. Mr. P. B. Warwick, of Cleveland, has closed with them a contract to install a storage battery for street car regulation. It is to discharge at the rate of 160 amperes at 1.9 volts, and comprises 240 nine-plate cells, 9x11, suspended style, electro-chemically formed elements. Mr. Warwick is, it is said, about to form a new company at Buffalo for the manufacture of his storage batteries.

INDIANAPOLIS PORK PACKING.—Kingan & Company, Limited, pork packers, have recently placed a very large contract with the Washington office of the Westinghouse Electric & Manufacturing Company for a complete power transmission plant for their extensive pork-packing establishment at Indianapolis. This company about three years ago installed a large direct-current electric plant, using Westinghouse apparatus, but have now found it advisable to put in alternating-current apparatus. The new installation will consist of two 300-kw engine type 2-phase A. C. 440-volt generators, and a number of induction motors, aggregating nearly 1000 horse-power.

THE MORRIS ELECTRIC COMPANY, of New York City, has just purchased an extensive plot of land in East Orange, N. J., on which it will build a factory. The property is situated on the D. L. & W. R. R. and has excellent transportation facilities. Work on the buildings will be begun in the near future, and the plant is expected to be in operation early in the spring. The buildings will be so arranged as to allow for additions as occasion may require. The growth of the manufacturing end of the Morris Electric Company has been so great during the past year, that the above step has proved necessary.

SIX NEW HOLLAND BOATS.—The Electric Boat Company, of Manhattan, has contracted with a firm in New Suffolk, L. I., for a site for a basin to establish a permanent testing plant at that place. A breakwater and basin will be built and half an acre of new land obtained by throwing up back of the breakwater the sand from the bay bottoms. A frame machine shop, 20x50 ft., and a larger engine house will be erected. About 50 men will be employed. It is stated that next year six boats of nearly the same pattern as the Holland will be built. Experiments will be made in Peconic Bay as before.

THE CONSOLIDATED TELPHERAGE COMPANY, of 20 Broad Street, New York, closed contracts last week with the Adolph Busch Glass Company, of St. Louis, Mo., and the Yale & Towne Manufacturing Company, Stamford, Conn., for overhead cableways with telphers. The installations will be quite novel and interesting and are another evidence of the great interest taken in this new electrical industry.

APPARATUS WANTED—Mr. Thomas T. Mather, manager of the Egg Harbor Electric Light Company, of Egg Harbor City, N. J., reports that it has made a new contract with the city for 23 arcs of 2000 candle-power and 8 incandescents of 16 candle-power for $1,590 a year for 10 years, moonlight a. m. schedule. It is now contemplating the establishment of a steam plant in place of the present one of gasoline engines, and Mr. Mather says that they will be in the market shortly for a 75-hp engine, 100-hp boiler and auxiliaries.

ELECTRICAL SUPPLIES IN MANILA.—The Manila *Freedom* is authority for the information that a large electrical supply house will likely be established in that city by Messrs. Bagnall & Hilles. This firm has houses in Singapore and Yokohama, and thinks that it is advisable to establish a branch at Manila in order to meet the growing demand there for electrical supplies.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, Chicago, has secured the contract to furnish the Corsicana (Tex.) Telephone Company with a 1200-capacity central battery telephone equipment. Owing to greatly increased business this company has been obliged to increase its factory floor space 10,000 sq. ft.

THE AMERICAN BRIDGE COMPANY has received the contract for the Santa Cruz bridge at Manila, P. I. The structure will consist of three spans, with a paved roadway 50 ft. wide, and sidewalks on each side—the bridge is patterned after the heaviest class of American highway bridge practice.

THE DYNELECTRON COMPANY has been incorporated in New Jersey to make electrical supplies and certain inventions. It has a nominal capital stock of $1,200,000 and one of the incorporators is George W. Angle, of 66 Broadway, New York City.

THE NAVAL ELECTRIC COMPANY, 95 Liberty Street, New York, desires to communicate with telephone constructing engineers with a view to the installation of an exchange of 5000 subscribers.

IRON is being delivered in large quantities for the extension of the Capitol Traction Company's system at Washington, and is being placed along the routes of the new roads.

General News.

THE TELEPHONE.

FARINA, ILL.—The Farina & Vandalia Telephone Company is a local concern with 10 subscribers.

NORTH AMHERST, OHIO.—The Amherst Home Telephone Company has been incorporated, with $25,000 capital stock.

HUBBARD, OHIO.—The Central District Printing & Telegraph Company has commenced work on a new exchange in this place.

LOS ANGELES, CALIF.—A competing telephone system is projected. Mr. W. H. Partridge is interested and expects to obtain a franchise.

SALT LAKE, UTAH.—A telephone company has been organized here to build a line to Los Angeles, connecting all towns on the way.

CALDWELL, OHIO.—The Caldwell Independent Telephone Company has been incorporated and will build a local exchange. Capital, $5,000.

ERIE.—The increase in subscribers for 1900 is put in the neighborhood of 36,000, carrying the total up to 142,000, with a waiting list of 5000.

PORTAGE, WIS.—The Central Wisconsin Telephone Company is putting in a metallic circuit line from this city to Westfield, via Oxford and Montello.

AKRON, OHIO.—The Akron People's Telephone Company is preparing to give free service to Doylestown. New lines are being built to Massillon and Canal Dover.

DAYTON, OHIO.—The City & Suburban Telegraph Association, owning telephone exchanges in this city and Cincinnati, has increased its capital stock from $2,500,000 to $4,000,000.

ALFRED, N. Y.—The Alfred Telephone & Telegraph Company now has 35 subscribers, 14 of which are of recent addition. Mr. W. S. Crandall states that the outlook for business is good.

MINNEAPOLIS, MINN.—The independent telephone plant of the Mississippi Valley Telephone Company, J. C. Hubinger, manager, will be sold by the sheriff to satisfy claims already filed amounting to $45,000.

GLOBE, ARIZ.—Judge William Whalley and D. Heron have purchased the telephone business of L. W. Allum, paying therefor $3,000. It is Mr. Allum's intention to install a modern electric light system here.

NASHVILLE, TENN.—The Cumberland Telephone Company announces the purchase of the telephone systems of Paris, Perryville, Elizabethtown, Ky., and Cleveland, Tenn., with 1000 subscribers and 400 miles of wire.

MANSFIELD, OHIO.—After recently refusing a franchise to the Star Telephone Company, the ordinance was again introduced in the Council last week and passed. This will make three telephone systems in Mansfield.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company is building branch exchanges in East Cleveland and Newburgh, which will soon be ready. The new switchboards, when completed, will give a total capacity of 15,000 drops.

HORTON, KAN.—The Horton Telephone Company expects to increase its business to 200 subscribers before long. It now has 155 subscribers and a switchboard capacity of 200. Since February last the gain in subscribers has been 55.

MADISON, WIS.—The Rock County Farmers' Telephone Company, capital $10,000, which is to build telephone lines in the country district near Jamesville, has been incorporated by Richard Valentine, C. S. Jackman and W. H. Palmer.

MILWAUKEE, WIS.—The new exchange building which the Wisconsin Telephone Company contemplated building on Fifth Street, near Grand Avenue, at once will, according to the latest reports, not be erected until the latter part of next year.

CARLINVILLE, ILL.—The Macoupin Telephone & Telegraph Company has finished the work of installing a system. This is an independent telephone company and the stockholders are local capitalists. This will give this city two telephone exchanges.

WELLSVILLE, OHIO.—After a long fight in the courts and in the City Council the Central District Printing & Telegraph Company has been granted a franchise to run a line through this place. On the leading street the poles must be used jointly with the street railway company.

MORRISON, ILL.—The Whiteside Harrison Telephone Company is operating five exchanges at Morrison, Sterling, Tampico, Prophetstown and Erie, Ill. It has a switchboard capacity of 400 drops and 340 subscribers. During the past season 70 instruments were installed. Some extensions will be made next spring.

KIBBIE, MICH.—The Kibbie Telephone Company operates lines in Van Buren and Allegan counties. It has a switchboard capacity of 365 drops and 300 subscribers. It has put in about 100 telephones since Jan. 1 last, and is steadily adding to the number. Mr. John H. Tripp is secretary and treasurer of the company.

TOLEDO, OHIO.—The Merchants' & Manufacturers' Association has taken action regarding the poor service given by the Central Union Telephone Company and its members have pledged not to pay until proper service is rendered. The company claims that the trouble is caused by the fact that it is installing a new system.

XENIA, OHIO.—The Citizens' Telephone Company has been granted a 50-year franchise for a local independent exchange. The management will be composed of local people headed by Marcus Shoup, but the majority of stock will be held in Chicago. The company will start with nearly 600 subscribers. The rates will be $1 for houses and $2 for business offices.

GRANITE CITY, ILL.—The City Council has granted a franchise to the Kinloch Telephone Company to erect poles and string wires along the streets of the city. By this franchise the company has a right to make connections all through the three cities and the managers will immediately commence the work of building up a central exchange for the East Side.

THE MEXICAN TELEPHONE COMPANY has recently completed the extension of its metallic system in the City of Mexico. The entire business section of the city now has a metallic system, whereas heretofore but a small area was thus supplied. The work upon the extension was commenced last spring and has cost about $22,000, which sum has been paid from the earnings of the company.

COLUMBIA, S. C.—A half-million-dollar company has been chartered here, to be known as the South Carolina Long Distance Telephone Company. Samuel L. Miller, of Columbia; John H. Schofield, of New York, and W. D. Melton, of Columbia, are the corporators. As previously announced, it is reported that the company proposes to secure control of the independent telephone lines in South Carolina.

NORFOLK, VA.—The Norfolk *Despatch* prints the details regarding the proposed organization of a local telephone company which shall later operate between Richmond, Washington, Baltimore, Newport News, Norfolk and other cities a long distance line. The capital stock is to be $200,000. It is stated that interests opposed to the Bell Company will, if necessary, take $100,000 stock in the new company.

BLAKELY, GA.—The Blakely Telephone Company is operating at Blakely and Arlington, each exchange having a capacity of 100 drops. At Blakely there are 96 subscribers, and at Arlington, 45. The company has 100 miles of toll line and is doing a flourishing business, about 33⅓ per cent of which is of recent acquisition. The company is projecting a 30-mile extension of toll lines. Mr. A. G. Powell is the president.

CADILLAC, MICH.—The Cadillac Telephone Exchange, H. W. Sill, proprietor, is rapidly increasing its business. During the last 15 months it has almost doubled its capacity. It now has 160 subscribers and a board capacity of 200. The exchange has been unfortunate, having in the past three years lost its entire equipment twice by fire. Notwithstanding these misfortunes, Mr. Sill reports that he is keeping up with the procession.

INDIANAPOLIS, IND.—A meeting was recently held at Marion to discuss the proposed consolidation of the various independent telephone companies in Northeastern Indiana. Those present were: L. C. Davenport, F. C. Oppenheimer, Hugh Daugherty and J. B. Salle, Bluffton; J. W. Sale, Fort Wayne, and H. L. Sale, Indianapolis. The Bluffton and Fort Wayne parties represented the United Telephone Company, which controls the independent systems of Huntington, Portland and Bluffton.

FOSTORIA, OHIO.—The Oil Belt Telephone Company, which was recently incorporated, expects to build exchanges in Bloomdale, Pemberville, Bradner, Prairie Depot and Arcadia. It is already operating an exchange at Rising Sun, Ohio, which was started on July 1 last. The company now has 45 subscribers, with 5 miles of local circuit and 4½ miles of toll line. Its rates are $12 for residences and $18 for business purposes. The incorporation of the company was recently announced in these columns.

HAGERSTOWN, MD.—The Maryland Telephone Company is operating a 500-drop board in its exchange in this city, and has 517 subscribers, with several more to be connected up. The company's system is extending so rapidly that it is contemplating installing a 700-number central energy system. It has in course of construction a line from Hagerstown to Westminster and intends to extend the same to Baltimore. It is also building a line from Hagerstown to Carlisle, Waynesboro and Chambersburg, Pa. Mr. P. D. Tebault is superintendent of the company.

KOKOMO, IND.—This city is enjoying the benefit of a telephone rate war. A competing plant has just been put in by a local company. The Bell Company, previous to the arrival of the competitor, charged $3 a month for business houses and $2 a month for residences. The new company put the price at $1.25 and $2. This came so near putting the old company out of business that the latter is contracting at 50 cents a month, with either monthly or yearly contracts. The new company still adheres to its original rate of $1.25, and has yearly contracts with a large number of subscribers.

DEERFIELD, WIS.—The Deerfield, Nora & Utica telephone line has been completed, with toll offices at Deerfield, Nora, West Church and Utica. At Utica it connects with the Prairie Queen line, which runs to Cambridge. On the two lines there are about 15 farmers' telephones and another line is being built from Utica to Stoughton, where it will connect with the Badger line. The two lines will be connected with the Utica-Stoughton line, and through the Badger all the lines will reach Madison and other points on its system. Already there is growing up a strong demand among the farmers not reached, and it will not be long before a farmer will consider it impossible to be without a telephone. N. A. Lee is president and N. Holman secretary of the Deerfield, Nora & Utica line.

ELECTRIC LIGHT AND POWER.

GLOBE, ARIZ.—Mr. L. W. Allum intends to install a modern electric light system in this place.

KOKOMO, IND.—The City Council is making an effort to purchase the local light and water plants.

HUNTINGTON, ORE.—Petitions have been presented to the City Council asking for electric street lighting.

INDEPENDENCE, ORE.—The City Council is debating the advisability of introducing electric street lighting.

APPLETON, WIS.—O'Keefe & Orbison will improve a water-power at Cheboygan, Mich., and erect a power transmission line.

MILWAUKEE, WIS.—The Nordling Manufacturing Company will build a new factory and talks favorably of driving its machinery electrically.

COTTAGE GROVE, ORE.—The electric power plant operated by A. Nelson was recently destroyed by fire. Loss, about $3,000; insurance, $2,000.

ALBANY, N. Y.—The Queens Borough Electric Light & Power Company has filed a certificate of increase of capital stock from $250,000 to $410,000.

INDIANAPOLIS, IND.—The International Union of Electric Workers has decided to remove its headquarters from Rochester, N. Y., to this city.

BALDWIN, WIS.—Ex-Sheriff E. J. Cave has purchased the franchise and plant of the electric light company and will improve and extend the system.

ST. LOUIS, MO.—The lighting committee of the board of public improvements will soon submit a report in favor of the extension of the boundaries of the underground district.

ALLEGHENY CITY, PA.—The Pennsylvania Light, Heat & Power Company, of Allegheny City, has purchased a lot on Margaret Street, Allegheny City, on which to erect a power house.

LAUREL, LA.—F. W. Pettibone has been granted the right of the streets and sidewalks for constructing and operating an electric light and power plant. Work on the plant is to be started at once.

RICHMOND, IND.—The City Council announces that it is ready to begin the construction of a new municipal electric light plant. The owners of the old plant are at a loss to know what to do with their property.

HARRISBURG, PA.—The Lawrence Light, Heat & Power Company, of New Castle, Pa., capital $10,000, has been chartered. The board of directors are: R. R. Quay, E. E. Hamilton, Gaylord Thompson, of New Castle.

WOODBURN, ORE.—The city authorities recently granted A. B. Kurtz a 30-year franchise for an electric light and water system. A two-year contract for electric lighting of streets and public buildings was also entered into.

MILWAUKEE, WIS.—The Sprague Electric Company, of New York, has secured the order for the generators and motors for the Gender Paeschke Manufacturing Company of this city. The Gender Paeschke Company will drive its machinery electrically and discard the present mechanical transmission method.

RACINE, WIS.—The S. Freeman & Sons Manufacturing Company has contracted for electrical machinery to operate its plant partially. The contract includes a 75-kw generator and motors aggregating 65 horse-power. The Northern Electrical Manufacturing Company, of Madison, secured the machinery contract.

SAN FRANCISCO, CALIF.—The Republic Power & Cyaniding Company, of Republic, Wash., is prepared to supply electric power throughout that flourishing mining camp. A commercial business in electricity for lighting and milling purposes will be carried on in addition to supplying current for use in the company's extensive mining works.

ELECTRICAL WORKSHOP FOR LEAGUE ISLAND NAVY YARD.—Plans are being drawn for the proposed electrical workshop and storehouse for equipment at the League Island Navy Yard, Philadelphia, Pa. The workshop will cost $84,000. The Government will also establish an electric light plant for the yard, to cost $20,000.

COLLINWOOD, OHIO.—The Collinwood electric light plant was recently put into operation. The village streets are lighted by 70 arc lamps. The inauguration of the service was attended with a demonstration. The plant is owned and operated by the village authorities. It was built by the Chase Construction Company, the Fort Wayne system being used.

PITTSBURG, PA.—A number of Western Pennsylvania capitalists have organized the Ellwood Power Company for the purpose of constructing an electric power transmission plant and utilizing the waterfalls of the Conoquenessing River in the operation of a number of manufacturing plants along the valleys of the Conoquenessing, Beaver and Allegheny rivers. The directors of the company are: S. A. Roelofs, R. A. Todd, H. P. Richardson and J. E. Aiken, of Ellwood City, Pa., and F. L. Roberts, of Pittsburg.

TORONTO, ONT.—Mr. W. T. Steward, electrical engineer, says in a communication to the mayor of Toronto, Ont., that if the Board of Control will postpone the letting of the street lighting contracts for the city for the space of two weeks, that he will engage to "bring in Americans representing several millions of dollars of capital, who will make a proposition to light your streets at a saving of from $40,000 to $45,000 per annum over and above any proposition heretofore made to the city." The city of Vancouver, Mr. Steward states, is saving $12,000 annually in its street lighting bill as the result of having acted upon his proposition, and he exhibits a recommendation from the mayor of Vancouver corroborating this statement.

STEALING POLES.—The police of the New York annexed district are looking for the thief who stole 75 poles, ranging in length from 35 ft. to 50 ft., from the Pelham Bay Electric Light Company. The company, which illuminates the highways of City Island and in the upper section of the Borough of the Bronx, distributed the poles through Pelham Manor, intending to set men to work putting them up. When the workmen came around they discovered that the poles were gone. The police say that a man who lives at City Island sold the poles to another lighting company for $400. He employed seven teams and gathered them up at night. The next day he delivered them to the purchaser, and after getting his money fled. The poles are valued at $700.

THE ELECTRIC RAILWAY.

ZARAGOZA, SPAIN.—Tenders for a tramway concession at this place will be received up to Nov. 27.

NAPLES, ITALY.—The street railway running from this city to Caivano is to be converted into an electric system.

BRUNSWICK, GA.—A franchise has been granted to Mike Brown, of Barnesville, S. C., and others, to operate a street car line in this city.

BECKWITH, ONT.—The Township Council has granted the right of way for the proposed electric railway from Carleton Place, Ont., to Lake Park.

NORFOLK, VA.—The plant of the Norfolk Railway & Light Company has been burned, at an estimated loss of $150,000. About 50 cars were destroyed

MARION, IND.—A resolution has been introduced in the City Council providing that the city purchase the electric railway of the Marion Transit Company.

SPRINGFIELD, OHIO.—The promoters of the Dayton, New Carlisle & St. Paris Electric Railway propose to build branch lines from New Carlisle to Troy and to Springfield.

TERRE HAUTE, IND.—The Wabash Valley Electric Railroad, which has a franchise over a number of country roads, has asked the city for a franchise of a number of streets.

ST. CHARLES, MO.—A 50-year franchise has been granted by the City Council to the St. Louis, St. Charles & Western Railway Company to operate an electric street car line.

SOMERVILLE, N. J.—The Mutual Traction & Illuminating Company has been incorporated. Capital, $100,000. Incorporators: Jose Eugenio Marks, Max Marx and Alvah A. Clark.

ROANOKE, VA.—At the annual meeting of the stockholders of the Roanoke Street Railway Company J. B. Fishburne was chosen president of the company and E. L. Stone, treasurer.

SHELBY, OHIO.—The City Council of Shelby has granted a franchise to the Citizens' Street Railroad Company, of Mansfield, which is building an electric road from Mansfield to Shelby.

COLUMBUS, OHIO.—The Cincinnati & Hamilton Railway Company has been incorporated by Powell Crosby, Charles T. McRea, David U. Hunt, John C. Rogers and William F. Hart.

FOSTORIA, OHIO.—Construction work has been started on the Fostoria-Findlay division of the Toledo, Fostoria & Findlay Electric Railway. Work on the power house has been started here.

PARIS, FRANCE.—The Compagnie des Tramways Electrique de Caen has been organized in this city, with a capital of 3,000,000 francs, for the purpose of building a proposed electric railway at Caen.

PITTSBURG, PA.—The employees of the Consolidated Traction Company of this city have laid before the management of the company a request for an increase of their wages from 20 to 23 cents per hour.

AUGUSTA, GA.—The Augusta Electric Railway Company has made a new departure in the construction of a two-story building, to be used as a club and reading room and gymnasium for its employees.

CLEVELAND, OHIO.—The Cleveland City Railway Company, which is equipping its Payne Avenue line with electricity, has sold the remaining cables as junk. They brought $600, the original cost being $7,500.

WHEELING, W. VA.—The Wheeling Traction Company has been incorporated. Capital, $10,000. Incorporators: H. Ford, A. M. Synder, F. A. Henry, A. R. Manning, Jr., and L. M. Hildreth, all of Cleveland, Ohio.

COLUMBUS, OHIO.—The Columbus, London & Springfield Electric Railway Company has increased its capital stock from $1,000,000 to $1,500,000. J. S. Harshman is president and Emmett Tompkins secretary of the company.

LIVERPOOL, ENGLAND.—It is stated that the Great Eastern Railway Company will apply to Parliament for permission to build a tunnel in this city, seven miles in length. The trains in the tunnel will be operated by electric power.

ALLIANCE, OHIO.—Owing to difficulties with the financiers the construction work on the Alliance, Sebring & Salem Electric Railway has been temporarily abandoned. It is claimed that the road will surely be built, however.

DAYTON, OHIO.—The Dayton & Maysville Electric Railway Company has changed its name to the Cincinnati, Dayton & Maysville Electric Railway Company. The company will build a branch line from South Lebanon to Cincinnati.

COLUMBUS, OHIO.—The Board of Public Works has recommended that a franchise be granted to the Urbana, Mechanicsburg & Columbus Electric Railway Company. Under the provisions the company must use the double-trolley system.

PARIS, FRANCE.—A system of electric railways is to be constructed in the department of Creuse. The lines are to run from Aubusson to Eymoutiers and to Auzances; from Gentioux to Bourganeuf, and from Vieilleville to la Souterraine.

RICHMOND, VA.—The Virginia Electrical Railway & Development Company, of Richmond, Va., expects to have its new plant in operation by December, or soon thereafter. The company proposes also to furnish electric power to consumers.

HUNTINGTON, IND.—The directors of the Oil Belt Traction Company have closed the contract with J. P. Dale & Company, of Chicago, for the building of the proposed electric road from this city to Warren, Bluffton, Montpelier and Portland.

INDIANAPOLIS, IND.—The Indiana & Ohio Traction Company has been incorporated with a capital stock of $750,000. James H. Simonson and A. S. Cloverdale, of Fort Wayne, Ind., and Ohio and Pennsylvania men are the incorporators.

FOND DU LAC, WIS.—Articles of incorporation of the Ripon, Dartford & Green Lake Electric Railway & Light Company have been filed. The incorporators are Y. S. Rountree, Ottmar Schallern and H. P. Cody, of Ripon. The capital stock is $100,000.

HOMESTEAD, PA.—A number of local capitalists of the borough of Homestead have organized the Homestead Belt Line Street Railway Company, and will construct an electric street car line from the Carnegie steel works around the outskirts of the town.

COLUMBUS, OHIO.—An extensive power house is to be erected by the Columbus, London & Springfield Electric Railway Company and the contract for the equipment of the same will be let soon. Contracts for the equipment of the road have already been placed.

PITTSBURG, PA.—The Dennis Construction Company of this city has received the contract for the construction of an electric railway between Indianapolis and Martinsville, Ind. The total cost of the road and its equipment will be $800,000, and the length will be 31 miles.

JACKSON, MICH.—The State board of supervisors has granted a 30-year franchise to the promoters of the Pontiac-Flint Electric Railway for the right of way over the Saginaw turnpike and the Fenton road. Bids for material and construction will be opened in a few days.

PITTSBURG, PA.—The Uniontown & Monongahela Valley Electric Company has awarded the contract for the construction of an electric road from Uniontown into the Masontown coke field, a distance of 20 miles. The contract calls for the completion of the work by April 1, 1901.

PITTSBURG, PA.—The Sharon & Butler Railroad Company has been chartered, with a capital of $600,000. The company will build a line 30 miles long from Sharon, Pa., to Brown's schoolhouse in Butler County. Mr. George W. Darr, of Pittsburg, is president of the company.

HANNIBAL, MO.—The Hannibal Railway & Electric Company has been incorporated. Capital, $100,000. Incorporators: E. D. Brewington, G. D. Clayton and E. P. Bowman, all of Hannibal; H. J. Beatty, J. K. Adams, W. S. Twiddy and R. C. Maroney, all of New York City.

WILMINGTON, DEL.—The Consolidated Safety Third Rail Electric Company, of Wilmington, has been incorporated. Capital, $100,000. Incorporators: W. F. McNamara, M. P. Davidson, both of New York City; G. W. Kimball, of Wilmington; Niles & Johnson, attorneys, New York City.

FREMONT, OHIO.—The annual meeting of the stockholders of the Toledo, Fremont & Norwalk Electric Railway Company was held here recently. The officers elected were: President, S. F. Angus; vice president, W. B. Comstock; treasurer, A. W. Comstock; secretary, W. A. Comstock.

GALION, OHIO.—At a meeting of the stockholders of the Ohio Central Traction Company, held a few days ago, it was decided to extend the line from this place to Crestline. Several routes are under consideration. The extension will cost about $80,000, and will necessitate an addition to the local power house.

TOLEDO, OHIO.—The power house equipment for the Toledo & Western Electric Railway Company will be purchased in the near future. The Cambria Steel Company has secured the contract for the steel rails. Among the promoters of this enterprise are Luther Allen and Judge C. M. Stone, of Cleveland, Ohio.

COLUMBUS, OHIO.—The Western Ohio Railway Company, of Lima, has been incorporated by F. D. Carpenter, L. M. Coe, Jacob Meyer, Frank N. Wilcox and James J. Hogan. Capital stock, $100,000. The company will build an electric road from Lima to Wapakoneta. The projectors are all Cleveland capitalists.

HILLSDALE, MICH.—The stockholders of the Escanaba & Lake Superior Railway have decided to equip the road with electricity. A large dam will be constructed in the Escanaba River and the water-power will be utilized for generating purposes. The cost of the proposed dam and power house is estimated at $155,000.

MARITZBURG, NATAL.—The Town Council of this place has decided that the proposed electric tramways shall be built and operated by the municipality. The power for the new system will be supplied from the existing electric light plant. The borough electrical engineer of Maritzburg can give further information regarding the project.

SAN FRANCISCO, CALIF.—The Independent Electric Light & Power Company, San Francisco, is now carrying the entire load of the San Francisco & San Mateo Electric Railroad. Two rotary transformers are in use, one in the Eighth Street station and one in Sunnyside. An additional rotary is being installed at each of these stations.

CIRCLEVILLE, OHIO.—J. M. Wilson and others, of Dayton, have applied to the commissioners of Pickaway County for franchises for two electric railways to cross the county. One of them is to extend from Columbus to Chillicothe, passing through Circleville, and the other from Columbus to Washington Court House, passing through Mt. Sterling.

SAN FRANCISCO, CALIF.—A large plant for the storage of crude petroleum is being constructed by the United Oil Producers' Company on the Oakland side of San Francisco Bay. A very large tank will be built, with the expectation of supplying fuel oil for the electric power house in Alameda and the Piedmont Electric Railroad power station in Oakland.

RICHMOND, VA.—Judge J. L. Haner, of Cleveland, Ohio, is interested in working up a company to build an electric railway from Petersburg to Richmond, Va., a distance of over 30 miles. It is reported that Judge Haner has an option on the franchise and property of the old Richmond & Petersburg Electric Railway Company, which was chartered some time ago.

APPLETON, WIS.—John I. Beggs, of Milwaukee, on behalf of the Fox River Valley Electric Railway Company, has arranged for work to begin at once on a temporary power house to operate the street railway and city lighting system. Next spring a permanent power house will be erected to furnish the needed power and sell power to small manufacturing plants.

GALION, OHIO.—The election of officers for the Ohio Central Traction Company, held here a few days ago, resulted as follows: Samuel C. Moorehouse, president and treasurer; Fred C. Boyd, vice-president; R. W. Johnson, secretary; directors, Samuel C. Moorehouse, Fred C. Boyd, of New Haven, Conn.; William E. Haycox, R. W. Johnson and A. W. Lewis, Galion.

JACKSON, MICH.—William A. Boyland, of New York, has secured electric railway franchises from Battle Creek to Ann Arbor, embracing Albion, Parma and Jackson and east of Jackson through Leonia, Grass Lake, Dexter and Chelsea. He has also filed an application in Ann Arbor. It is his intention to complete the line to Detroit, giving 140 miles of continuous electric railway travel.

HAMILTON, OHIO.—The Millcreek Valley Street Railway Company has closed contracts for the erection and equipment of new car barns and power house at Hartwell. C. Iliff, of Cincinnati, was given the contract for the construction work, the McIntosh-Seymour Company for engines, and the General Electric Company the generators. The power house must be completed by Feb. 1, 1901.

PITTSBURG, PA.—The Southern Traction Company of this city, which recently absorbed the West End Traction Company, is contemplating a number of improvements on the newly acquired property. The road is to be double-tracked the entire length and a large number of new cars are to be added to the equipment immediately. It was for this purpose the company recently issued $4,000,000 bonds.

ATHENS, OHIO.—The Athens, Nelsonville & Hocking Valley Traction Company will be incorporated in a few days, with a capital of $600,000, to build a road from Athens to Nelsonville and Murray City, with a branch line to Millfield, Jacksonville, Trimble and Glouster. Thomas A. Selz, S. R. Pine, H. C. Haning and Robert Klein, of Dayton, and H. H. Homing, of Athens, are promoting the enterprise.

BROCKTON, MASS.—The board of railroad commissioners has authorized the Brockton Street Railway Company to purchase the property and franchises of the West Roxbury & Roslindale Street Railway, and to issue $800,000 capital stock, to be exchanged share for share with that of the purchased company; also to purchase the South Shore & Boston Street Railway, and to issue $865,000 additional capital stock for that purpose.

SANDUSKY, OHIO.—Samuel R. Bullock has sold the control of the Sandusky Gas & Electric Light Company's plant and the People's Electric Railway Company to Charles D. Barney, a Philadelphia banker, representing an Eastern syndicate. It is reported that the Cleveland owners of the Sandusky & Interurban and the Lorain & Cleveland road are negotiating for the purchase of the properties mentioned, with a view to consolidating the three roads.

DES MOINES, IA.—It is announced that a syndicate has been formed for the purpose of building an electric or compressed-air railway out of Des Moines, to connect with the Iowa Central Railway at Newton. Incidentally, it desires to acquire a controlling interest or working agreement in the Des Moines Street Railway Company. L. M. Hanna, of Cleveland, a brother of M. A. Hanna, and J. C. Rockefeller, of the same city, brother of J. D. Rockefeller, are said to be the principal stockholders.

BIRMINGHAM, ALA.—At a recent meeting of the stockholders of the Birmingham Railway & Electric Company it was agreed to consolidate the company's properties with those of the Birmingham Traction Company and the Birmingham, Powderly & Bessemer Street Railway, which the Birmingham Traction Company absorbed several months ago. The consolidated company will be known as the Birmingham Railway, Light & Power Company, and will have the same capital stock as the old company, namely, $1,500,000.

TOLEDO, OHIO.—At the recent annual meeting of the stockholders of the Toledo Traction Company, the following officers and directors were elected for the ensuing year: Directors, Albion E. Lang, Norman B. Ream, John B. Dennis, James A. Blair, W. B. Hale, Barton Smith, Rufus B. Baker, Thomas H. McLean, W. H. McLellan, Titus B. Terry and George W. Hale. The old officers were re-elected as follows: President, Albion E. Lang; vice president and general manager, Thomas H. McLean; treasurer, J. B. Dennis; secretary, Barton Smith.

CLEVELAND, OHIO.—What is said to have been the fastest run ever made between this city and Akron was made on election night by a special car over the Akron, Bedford & Cleveland line of the Northern Ohio Traction Company. The car left the Public Square this city at 3:30 a. m. and arrived in Akron at 4:44, the distance being about 35 miles. The car carried election returns from this city to Akron, and was given a clear track. Five stops were made and the actual running time was 1 hr. 01 min. The road has a number of sharp curves and grades.

ADELAIDE, SOUTH AUSTRALIA.—It is likely that the Colonial Government will undertake the conversion of the 50 miles of horse railway in this city to electric traction, although the Westinghouse Company and Mr. Callender have appeared before Parliament for the purpose of securing authority to undertake this work. The South Australian Parliament recently issued a bill ordering all the horse railways in the colony to be changed over to electric system as soon as possible. At Sydney the work of changing the steam and horse lines to electric system is nearly completed.

MARINETTE, WIS.—Isaac Stephenson, president of the Escanaba & Lake Superior Railway Company, has stated that the new road would be run electrically within a year or two. Plans are now being made for putting into use the vast water power of the Escanaba River, along the bank of which the railroad runs. One of the water powers, 20 miles above Escanaba, has a 40-foot head, and that alone would furnish power for all the trains along the road. The line is 75 miles long and extends from Escanaba to Channing, Mich., where it will connect with the Milwaukee road.

CONNECTICUT TROLLEYS.—A gang of 250 laborers began work right after election building the trolley road from the Port Chester line toward Greenwich village. Eight miles of road will be built, a greater part of it parallel to the New York, New Haven & Hartford Railroad, thus providing the missing link in the trolley service between New Haven and New York. The trolley road is to be completed by spring, as the charter of the Greenwich Tramway Company expires with the next sitting of the State Legislature, and owing to the opposition of the summer element here there would probably be much trouble in securing an extension of time.

THE AUTOMOBILE.

THE PARRY MANUFACTURING COMPANY, Indianapolis, Ind., is about to begin the erection of its new automobile plant in that city.

THE CALIFORNIA AUTOMOBILE COMPANY was recently incorporated, with San Francisco as the place of business. The directors are Henry C. Whittemore, Michael J. Kerwin, Charles E. Hancock, Sherwood Bird and Norton J. Hulse, all of San Francisco. The capital stock is $150,000.

SAN FRANCISCO, CALIF.—The Automobile Club of San Francisco through its treasurer, A. E. Brooke Ridley, has about completed arrangements for leasing the building now occupied by the Mercantile Library. The ground floor will be used to accommodate the vehicles of the members and commodious offices, etc., will be fitted up.

AUTOMOBILE EXHIBITION IN WASHINGTON.—Preparations are well under way for the automobile show to be given in Convention Hall, Washington, D. C., under the style of the National Automobile and Sportsman's Exhibition. The show will be held during the week of Dec. 10, and gives promise of being largely attended.

DISTINGUISHED AUTOMOBILISTS.—A despatch from Paris says that the automobile craze has seized the Sultan of Turkey, and he has ordered three machines. The Gaekwar, of Baroda, fascinated by automobiles, takes two back to Baroda. The King of the Belgians has put a machine on his yacht to take wherever he sails.

NEW INDUSTRIAL COMPANIES.

THE COLUMBIA ELECTRIC SUPPLY COMPANY, of Jersey City, has been incorporated. Capital, $50,000. Incorporators: C. E. Sutherland, F. L. Eckerson, G. W. Flaacke.

THE A. E. HEMMEL ELECTRIC COMPANY, of New York City, has been incorporated. Capital, $3,000. Directors: Andrew Reich, Jr., and J. R. Simpson, New York City; G. Bayard Miller, Brooklyn.

WARREN, OHIO.—The Economy Electric Company, of Warren, has been incorporated, to manufacture porcelain and clay insulators. Capital, $50,000. Incorporators: P. L. Webb, G. H. Jones, G. B. Sawyer, J. W. Powers and H. W. Smith, Jr.

DETROIT, MICH.—The Capital Electric Manufacturing Company, of Detroit, has been incorporated, to manufacture and sell electrical supplies. Capital, $30,000. Incorporators: A. Q. Bresler, T. G. Rakestraw, W. J. Bowen and E. A. Bresler, all of Detroit.

SEDALIA, MO.—The Economy Steam Heating & Electric Company has been incorporated here. Capital, $50,000. Incorporators: I. H. Babcock, C. R. Bishop, W. D. Hall and J. D. Walsh, all of Lockport, N. Y.; F. A. Bishop, of Hannibal; C. E. Yater, R. Mowbray, both of Sedalia.

THE HUNGERFORD ELECTRIC & MANUFACTURING COMPANY, of New York City, has been incorporated to do a general electric and manufacturing business. Capital, $1,500,000. Incorporators: J. S. Honeycombe, A. W. Rose, P. Dwight, E. B. Merrill, S. D. Maynard, all of New York City; E. B. Merrill, attorney, New York City.

THE MODERN ENGINEERING COMPANY, of Wellsville, Ohio, has been incorporated with a capital stock of $10,000, with privilege of increasing to $150,000, for the purpose of manufacturing and selling mechanical and electrical appliances. Incorporators: Howard L. Kerr, Charles R. Dallas, G. B. Thurber and C. B. Reed, of Pittsburg, and Thomas C. Carlton, of Chicago. The company will erect a plant.

LEGAL.

TELEPHONE PRIVILEGES IN OHIO.—The Supreme Court of the State of Ohio has reversed the decision of the Circuit Court in the case of the City of Zanesville vs. the Zanesville Telegraph & Telephone Company, involving the right of telephone companies to appeal to the Probate Court in cases where they are not satisfied with the privileges granted by the Council or other legislative bodies of municipal corporations. The City Council not taking the desired action, the company appealed to the Probate Court. The Council contended that the statute authorizing and requiring the Probate Court to act in the matter was unconstitutional, claiming that it conferred executive powers upon the court. The Court of Common Pleas sustained this decision, and the Circuit Court was appealed to. The latter court reversed the decision of the former court, and the case was taken to the Supreme Court. This court recently reversed the decision of the Circuit Court. It held that an appeal from the Council to the Probate Court is not a proper proceeding, as it is a usurpation of a legislative function by a branch of the judiciary. The decision affects local situations in many Ohio towns, and it has been hanging fire for several years.

ELECTRIC POWER HOUSE NUISANCE.—Mrs. Sarah Bly, as a leaseholder of 33 West Twenty-sixth Street, New York City, used as a boarding house, brought suit two years ago to recover damages she claimed to have sustained by the Edison Electric Illuminating Company so operating its power house at 45 West Twenty-sixth Street as to cause a nuisance to her because of smoke, cinders, incessant vibration and noise occasioned. Mrs. Bly's first lease began in 1886, and expired in May, 1890, and it was during this period that the power house began to be operated. Witnesses for Mrs. Bly, who had lived in her house, testified on the trial that the vibration of the building was a continuous annoyance, and that owing to it is was difficult to sleep; that it caused clocks to stop and pictures to become deranged; that the ceiling cracked and fell, and the windows constantly rattled. Prof. W. Hallock, of Columbia University, testified that upon leaning against the partition wall of the house he could feel the vibration very perceptibly, and by means of a delicate instrument he found that the partition wall vibrated one-one-hundredth of an inch continuously and in consonance with the revolutions of the company's engines. The experts of the company, in their testimony, attributed in part the alleged vibration to the passing elevated trains. A judgment at Special Term awarding Mrs. Bly an injunction and $4,000 damages was last week modified by the Appellate Division by reducing the award to 6 cents. The court holds, in an opinion by Justice O'Brien, that damages not being recoverable for a greater period than six years, and during such period Mrs. Bly being in possession under a lease or leases which were subsequent in date to the construction and operation of the company's power house, and she having taken a lease with knowledge of the existing nuisance, was entitled to only nominal damages. The damages resulting from loss of business caused by vibration, smoke and cinders from the power house were, in effect, damages to the rental value of the premises, and could not be recovered by the plaintiff as lessee. Had she proceeded promptly, the court says, she would have been entitled to an injunction restraining the company from prosecuting its business in a way that would inflict damages upon her or destroy her comfort or health. Having, however, removed from the premises after the expiration of her lease last April, she would no longer be benefited by an injunction, and none should be granted to her.

OBITUARY.

JOHN PILLING.—We regret to note the death of Mr. John Pilling, of Newark, Del., president of the American Hard Fibre Company, and one of the leading woolen manufacturers of this country. He was an Englishman by birth, but American in every fibre of his being. He took a distinguished part in politics and made a record for honest work. He will ever be remembered as one of the strong men of Delaware.

FREDERICK W. ROYCE, widely known as an inventor, electrician and veteran telegraph operator, dropped dead from apoplexy in Washington on Nov. 16. He was 61 years old, and a native of Delaware. Mr. Royce was among the first to send a mesage on the old printing telegraph instruments, and became one of most expert telegraphers in the country. In sending press telegrams he often attained a speed of 60 words a minute. He leaves a wife, who is seriously ill, and two sons and a daughter, one son being Frederick Royce, Jr., the New England traveling agent of the Baltimore & Ohio Railroad. The old firm of Royce & Marean was a leading factor in the electrical supply business of Washington.

PERSONAL.

MR. HORATIO A. FOSTER has opened at 310 Chestnut Street, Philadelphia, Pa., an office, where he will engage in general electrical engineering practice and report upon street railway, electric lighting and power transmission properties. He refers to some of the largest power companies, etc., as to his work.

MR. V. G. APPLE, the secretary of the Dayton (Ohio) Electrical Manufacturing Company, has been in town during the past week, chiefly at the automobile show in Grand Central Palace, where a neat exhibit has been made of the Apple gas engine igniters, sparking coils, etc. These devices are becoming widely known in the automobile field.

MR. JAMES L. TAYLOR has been elected third vice-president of the Consolidated Railway Electric Lighting & Equipment Company. He was until recently the general European agent of the Pennsylvania Railroad in London, and had a railroad experience in this country in prominent positions on the lines forming the Plant and Southern Railway systems.

MR. ALEXANDER FIELDS, said to be a Northern capitalist and now at Asheville, N. C., for a short while for his health, will build several telephone exchanges and electric light plants in the South, beginning about the first of the year. He is already largely interested in plants in the South and thinks it a good field for investment. He will buy largely of telephone and electric light apparatus and supplies in January.

MR. R. H. LAUDER, chief engineer of the construction department of the Electric Storage Battery Company, lectured before the Mechanical Engineers' Club of the University of Pennsylvania on Nov. 9. After describing the reasons for installing batteries in lighting and railway plants and showing how the output of the batteries varied with the rate of discharge, views of many of the installations made by this company were thrown on the screen and the principal features of installation and control were explained.

ISHAM—MILLER.—The marriage of Mr. Edward S. Isham, Jr., of the General Incandescent Arc Light Company, to Miss Laura Miller, daughter of Mrs. C. A. Miller, of New York City, took place on Nov. 14 in the Church of the Incarnation, Thirty-fifth Street and Madison Avenue, New York. The ceremony was performed by Bishop Littlejohn, of Long Island. The betrothal service, which took place at the foot of the altar steps, was performed by the Rev. Dr. William Grosvenor, rector of the church. The bride's matron of honor was her sister, Mrs. Wallace Percy Knapp. The bridesmaids were Miss Susie Dimock, daughter of Henry F. Dimock; Miss Frances Isham, a sister of the bridegroom, and Miss Evelyn Willing and Miss Billings, of Chicago. Mr. Isham's best man was Alison Armour, and George S. Brewster, James E. Miller, J. Wesley Doane, G. Beekman Hoppin, William B. Isham and Pierrepont Isham were ushers. After their honeymoon trip Mr. and Mrs. Isham will reside for the winter with the bride's mother at her residence in West Thirty-seventh Street.

EDUCATIONAL.

LOWELL FREE LECTURES.—The Lowell Institute announces a free course of lectures in the Massachusetts Institute of Technology, Boston. The courses include 12 laboratory exercises in general electrical testing, given by Assistant Professor Frank A. Laws, 12 lectures on Electro-chemistry by Assistant Professor H. M. Goodwin and 12 lectures on Electro-metallurgy by Professor H. O. Hofman.

THE UNIVERSITY OF ILLINOIS has placed orders for several new pieces of apparatus for the electrical engineering laboratory equipment, comprising polyphase rotary converters, transformers and regulators for polyphase work, induction motors and Weston instruments. This apparatus will afford much needed additional facilities for regular electrical laboratory training, owing to the increased number of students in attendance in these courses.

Trade Notes.

THE AMERICAN STEEL & WIRE COMPANY has ordered from time to time 18 Cross oil filters for use in its plant at Chicago, Ill.

SPRINGS.—Extension, compression, torsion and flat springs for a great variety of uses constitute the subject of a 62-page catalogue of the American Steel & Wire Company. Many styles of springs are illustrated.

BOLT THREADING MACHINE.—The Webster & Perks Company, Springfield, Ohio, in a new catalogue describes and illustrates its solid die automatic threading machines and self-oiling grinding and polishing machines.

A FEW FACTS ABOUT CINCINNATI.—The Cincinnati Milling Machine Company is distributing with its compliments an 18-page pamphlet, giving considerable information about industrial Cincinnati. It is an interesting story.

NEW FACTORY.—The Homer Commutator Company, Cleveland, Ohio, will about Dec. 1 move into its new and extensive factory at the corner of Mason Street and Willson Avenue. It will have in its new plant the best facilities for the manufacture of commutators.

PLUG CUT-OUTS.—It is evident from the large number of orders recently received that the trade appreciates the large stock of Edison plug cut-outs of all sizes, which the Western Electric Company is carrying in Chicago. Immediate shipment can be made of any style and at attractive prices.

THE ELECTRIC APPLIANCE COMPANY, Chicago, states that its sales of Packard lamps during the past year are nearly double that of any previous year. This record has been made in the face of the fact that the conditions of sale of incandescent lamps are more severe than ever before.

FABIUS HENRION, of Nancy, France, sends us a very handsome catalogue of large oblong form, filling 74 pages, and illustrated with several hundred cuts and diagrams of dynamos, motors, lamps, brushes, meters, fixtures, shades, heaters, etc. His Paris headquarters are now at 113 rue Reaumur, near the Bourse.

ASBESTOS BULLETIN.—Considerable information about pipe and boiler coverings of asbestos is given in a little pamphlet being distributed by the H. W. Johns Company, New York. Tables are given showing the advantages derived from the use of such coverings. The method of applying the covering is well illustrated.

CELLULOID BILL FILE.—The Springfield Machine Tool Company, Springfield, Ohio, has brought out a unique bill file. It has a celluloid back, on which are printed some illustrations and information about some of the machines manufactured by this company. These files may be had on application by any one using machine tools.

"2500 WITNESSES" is the suggestive title of a 36-page production of the advertising department of the B. F. Sturtevant Company, Boston, Mass., being, as announced in the sub-title, "A List of Buildings and Sundry Steamships wherein the Sturtevant System or Apparatus has been installed for the purposes of Ventilation and Heating."

MR. E. WOODRUFF, president, and Mr. Thomas Elliott, chief engineer of the Atlanta Railway & Power Company, of Atlanta, Ga., have just awarded the Siegrist Lubricator Company of St. Louis, Mo., a contract to equip all machinery in their new 12,000-hp plant with the Siegrist automatic oiling system, although a gravity system was ordered with the machinery.

GENERAL ELECTRIC BULLETINS.—Recent bulletins issued by the General Electric Company relate to electrostatic ground detectors and small continuous-current stationary motors type C. A., the third bulletin containing a list of polyphase power plants equipped with General Electric apparatus. The numbers of the bulletins are 4231, 4232 and 4230, respectively.

RAILWAY MOTORS.—The Westinghouse Electric & Manufacturing Company, in a very attractive catalogue recently brought out, gives many illustrations of railway apparatus, supplemented by a few views of typical power stations. A brief description of the various machines is also given. The illustrations are remarkably clear and many of the detail parts are shown.

FORT WAYNE APPARATUS.—The Cincinnati office of the Fort Wayne Electric Works reports closing a contract for a 75-kw, low-frequency alternator and three enclosed arc lamps, to be installed at Waynesville, Ohio. The engine came from the Erie City Iron Works; the boiler from the Gem City Boiler Company. The material is for a combined water and electric light plant.

A HANDY DESK RULE.—The Magnolia Metal Company, 266 West Street, New York, has gotten out a handy and useful 15-in. desk rule, which it is distributing to the trade with its compliments. The rule will be found very useful to anyone and will at the same time remind the user that Magnolia metal is a standard commodity in the market and well known by all machinery men.

ENGLISH CATALOGUES.—We have received copies of two catalogues of the General Electric Company, Limited, London, England, one being on the subject of electric bells, batteries, pushes, indicators, lightning conductors, speaking tubes, telegraph apparatus and general telegraph supplies, and the other relating to wires and cables, conduits, insulators, etc. Both catalogues are fully illustrated.

THE WESTERN ELECTRIC COMPANY'S new fixture catalogue contains reproductions of the various styles and designs of thoroughly first-class goods. Not only are plain and ornamental fixtures for residences displayed, but those for offices, factories and stores as well. The needs of office men, doctors, dentists and artisans have been considered in the line of specialties. A copy will be sent on request.

CORRESPONDENCE SCHOOL OF CIVIL ENGINEERING.—The International Correspondence Schools, Scranton, Pa., describe in a pamphlet of recent issue their courses of study in civil, railroad, bridge, municipal and hydraulic engineering and surveying and mapping. An outline of the studies taught in the civil engineering schools is given, with much other information on the general subject of correspondence instruction.

THE GARTON-DANIELS COMPANY, of Keokuk, Ia., is highly gratified to find a 33⅓ per cent increase in its business over last year, which was double that of any previous year. The adoption of its lightning arresters on many of the new installations of the year is indicative of their high merit. This company expects to place some new specialties on the market in the near future, with which it has been experimenting for the past year.

THE RALEIGH HOTEL PLANT.—We published in our last issue an illustrated description of the lighting and power plant of the Raleigh Hotel, Washington, D. C., in which the statement was made that a Western Electric automatic switch was used in connection with the operation of the 10-hp motor and triplex pump combination. We are now informed that the automatic controlling device is that of the Automatic Switch Company, of Baltimore, and not of the company first named.

THE HYATT ROLLER BEARING COMPANY, Harrison, N. J., has secured the contract for the shafting equipment in the new works of the Raymond Manufacturing Company, of Guelph, Ont. Also the complete equipment for the Roanoke Mills, No. 2, of the Patterson Textile Company, Roanoke Rapids, N. C., and of the electric power transmission machinery, including two quill outfits, in the power house of the Roanoke Navigation & Water Power Company, Roanoke Rapids, N. C.

THE CANADIAN CORRESPONDENCE SCHOOLS, of Toronto, Ont., enters as a new factor into the educational development of Canada. The purpose of these schools is to carry on correspondence instruction by mail, after the manner of the correspondence schools in the United States. Among the subjects, the schools will have courses in electrical lighting, electrical engineering, stationary steam and hydraulic engineering. Mr. A. J. Pell is manager and E. H. Richard superintendent.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, has just installed a 50-hp, direct-connected teaser equipment for the Boston *Journal*. It has also sent machines of this type to England for one of the large printing establishments of London. October is reported by the Bullock Company as the greatest in the history of its business. The company is making two additions to its plant in Norwood—one an extension of the machine shop, the other a foundry and carpentry shop.

CATALOGUES.—The solid artistic value of a Bartlett catalogue has long been appreciated by all the leaders in the older branches of industry. It is, therefore, curious to note that Bartlett & Company have soon captured also the new field of automobilism. No fewer than eight of the leading concerns at the Automobile Club's show in Madison Square Garden—Electric Vehicle, Riker, Daimler, Reading, International, National, Locomobile, Automobile of America—have all gone to the Orr Press for their literature of exploitation. The results are uniformly admirable.

LARGE CONTRACT.—One of the largest contracts for electrical machinery let during the year has just been closed by the Bullock Electric Manufacturing Company, Cincinnati. It amounts to $100,000 and calls for a complete electrical equipment for the McCloud River Electric Power Company, of Shasta, Calif. Four generators of a total capacity of 2000 kilowatts will be used for transmitting current 30 miles from the generating plant to the great copper mines just south of Shasta, where the power is to be utilized in the operation of heavy mining machinery. The plant will utilize also water-power largely.

LARGE PURCHASE OF ELECTRICAL APPARATUS.—The Gregory Electric Company, 54 South Clinton Street, Chicago, announces in a circular that it has purchased the entire stock of completed machines, instruments and supplies of the Siemens & Halske Electric Company of America. The Gregory Company was also the highest bidder for the entire stock of completed machines of the Gibbs Electrical Manufacturing Company, of Milwaukee, and secured the entire lot. All of the latter are brand new, latest type multipolar machines, ready for immediate shipment. The circular gives the list of the machines embraced in the two purchases.

CLOOS HIGH TENSION SPECIALTIES.—Jacob Cloos, Milwaukee, Wis., the inventor of the Cloos high tension specialties, has a new junction box and also a new oil switch. Mr. Cloos has equipped a shop for manufacturing his junction boxes and oil switches and is receiving orders at this early date. A contract has been received from the Hatch Smelting Company, of Green Bay, for 42 special switches. The switches will be designed as follows: For operating of 2500 volts; to carry 150 amperes; to be double-pole, double-break, double-throw. A feature of these switches will be that they will automatically throw over at the rate of three times per minute.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, reports a phenomenal business in power machinery. Two large orders were from Swist & Company, Atlanta, Ga., consisting of direct-connected generator with an engine and switchboard and all other electrical appliances for its new plant in process of building at Atlanta. Another order is for the Nelson Morris Company, Union Stock Yards, Chicago, consisting of slow-speed belted type generator, to be installed in the Morris company's new box factory. Another order is for the Griffin Wheel Company, Chicago, to be installed in its new Kansas City plant, of a slow-speed belted type generator and several motors.

HEATING AND VENTILATION.—The B. F. Sturtevant Company, Boston, Mass., has issued the fourth edition of its catalogue, No. 66. This catalogue describes the Sturtevant system of heating, ventilating and moistening in textile manufacturies. The text consists of a reprint of the paper read before the New England Cotton Manufacturers' Association, by Mr. Eugene N. Foss, general manager of the B. F. Sturtevant Company. Illustrations show the apparatus used in this work, and by means of several diagrams the method of ventilating, heating, etc., is clearly shown. At the back of the catalogue is given a list of textile mills in the United States and in Canada, in which the Sturtevant system is in use.

THE ONONDAGA DYNAMO COMPANY, Syracuse, N. Y., is feeling the results of the recent election. It reports that there is a greatly improved prospect for good business, it having all the work it can do for three or four months to come. Several large generators are being built for electric railways and a great many factory orders have been placed with it. The company will have a new representative in New England, at Bridgeport, Conn., very shortly. Mr. E. C. Crocker will take up its interests in that section, while the New York office is moving to Rooms 29 and 30, 39-41 Cortlandt Street. The company manufactures the well-known "Clover Leaf" type of machine, in addition to other forms, for belted and direct-connected service.

ADJUSTABLE LAMP FIXTURES.—The O. C. White Company, of Worcester, Mass., is manufacturing an enormous number of adjustable shop fixtures for incandescent lamps this fall. Recent installations have been made by it in the shops of the New York Ship Building Company, at Camden, N. J.; New England Watch Co., Waterbury, Conn.; American Optical Company, Southbridge, Mass.; Westinghouse Machine Company, Pittsburg, Pa.; C. B. Cottrell & Sons Company, Westerly, R. I.; Bullard Machine Tool Company, Bridgeport, Conn.; Carnegie Steel Company, Pittsburg, Pa.; S. S. White Dental Manufacturing Com-

pany, Prince's Bay, N. Y., and R. Hoe & Company, New York. In the offices of many of these firms it has also installed its standard adjustable desk fixtures.

THE CHASE-SHAWMUT COMPANY, the well-known electrical manufacturer of Boston, Mass., has just removed from its old quarters on Fort Hill Square to the new Atlantic Building at 390 Atlantic Avenue. On the ground floor it occupies light, commodious offices, and the fourth floor of this large building is taken up with its shops. Here it will be able to produce in even larger quantities than heretofore its many specialties, among which are such well-known goods as the Shawmut tested fuse wire and links, Cartwright enclosed fuses, Chase flexible conduit couplings, Chase junction and outlet boxes, Monadnock knife switches, Cushing theatre switchboards and Boston cable clips. It is the company's claim, however, that even with its improved facilities it will hardly be able to better the quality of its products, because it has always ranked among the best. Besides manufacturing new apparatus, the Chase-Shawmut Company makes a specialty of the purchase, exchange and renewing of old electrical machinery and apparatus, and for this department it now has considerably more room. All in all, this firm is now in an enviable position for the operation of an already extensive business.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED, NOV. 13, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

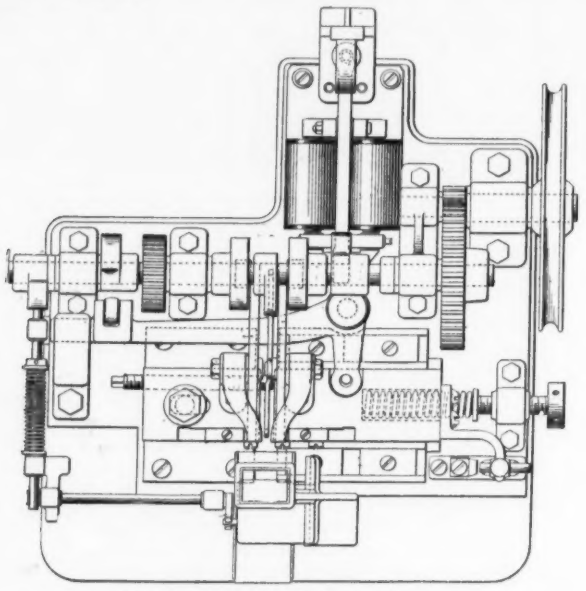
661,491. EMERGENCY BRAKE SWITCH; W. M. Brown, Johnstown, Pa. App. filed Oct. 14, 1898. Details of the mechanical construction of a switch for throwing the motors into a closed short circuit to retard the car.

661,516. TROLLEY; H. S. Goughnour, Johnstown, Pa. App. filed March 21, 1900. To prevent the trolley from striking cross wires in case it leaves its own wire, the upward movement of the trolley serves to disconnect the spring which forces it upward and allows trolley to fall to a horizontal position.

661,518. CONTROLLING DEVICE FOR ELECTRIC CIRCUITS; E. W. Hammer, Chicago, Ill. App. filed Aug. 31, 1899. An electric device comprising two coils, one in a main circuit and the other in a shunt circuit, and a controllable conductor connected with the main circuit in advance of the coil therein and with the shunt-circuit below the coil therein, whereby the current through said latter coil is varied by manipulating said controllable conductor.

661,520. AUTOMATIC STEERING DEVICE FOR TORPEDOES; Caryl D. Haskins, of Newton, Mass. App. filed Aug. 2, 1897; renewed April 12, 1900. (See Current News and Notes.)

661,538. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES: C. W. Kragh, Madison, Wis. App. filed Sept. 11, 1899. Relates to the arrangement of the spring.



661,588.—Electric Welding Apparatus.

661,555. FIRE ALARM; A. A. Ross, Montgomery, Ala. App. filed March 15, 1900. A fragile sealed tube in the form of a hook and containing volatile material, normally holds the alarm out of operation, but will break under heat and permit the alarm to be sent in.

661,588. ELECTRIC WELDING APPARATUS; A. F. Rietzel, Lynn, Mass., June 1, 1899. The machine is so organized that its operations take place in repeated cycles. The article to be welded is placed in the machine, being fed to it automatically or by hand. It is then clamped, the current is turned on, pressure is applied to upset the joint when the parts are sufficiently heated, then the clamps are opened and the welded article is taken out, leaving the apparatus ready for another article and a repetition of these steps.

661,589. ELECTRIC WELDING APPARATUS; A. F. Reitzel, Lynn, Mass. App. filed Sept. 23, 1899. The apparatus includes an electric heating device, an electric welding device, means for holding one part of the work in the heating device independently of other parts, means for bringing said part in the heating device into the circuit of the welding device and means for including another piece of work therewith in the circuit of the welding device.

661,600. TROLLEY WHEEL; T. I. Duffy and C. S. McMahan, Chicago, Ill. App. filed July 16, 1900. Contact springs are arranged peculiarly to bear against the wheel.

661,610. PROCESS OF MANUFACTURING INCANDESCENT BODIES; Carl Kellner, of Vienna, Austria-Hungary. (See Current News and Notes.)

661,616. ALARM AND RELEASING MECHANISM FOR FIRE ENGINE HOUSES; E. P. Matter, Alexandria, Va. App. filed March 13, 1900. When an alarm of fire is sent in from a box or other point the horses are released, the electric releasing mechanism cut out of circuit, and a local alarm brought into circuit to indicate the point from which the alarm has been sent.

661,666. SYSTEM OF ELECTRIC TRAIN CONTROL; Charles B. Martin, of New York. App. filed Oct. 23, 1897. (See Current News and Notes.)

661,669. CONNECTING CONDUCTORS TO CARBON BRUSHES; A. L. Rohrer, Schenectady, N. Y. App. filed July 22, 1898. Consists in a clip designed to fit over the outside and top of the brush and to which the conductor has previously been secured. This clip is soldered firmly to the brush, and the joint is afterward electroplated with copper or other good conducting metal.

661,714. TELEPHONE CIRCUIT; I. H. Farnham and G. W. Davis, Wellsley, Mass. App. filed May 11, 1900. Circuit and apparatus for telephoning between trolley cars and central station.

661,719. RECTIFIER OF ALTERNATING POLYPHASE CURRENTS; L. H. Haynes, Newton, Mass. App. filed Dec. 30, 1899. This invention is the combination of a plurality of pairs of collector-rings, one pair for each phase, of a polyphase current with at least one commutator-segment for each collector-ring, all the collector-rings and segments being actuated by a motor.

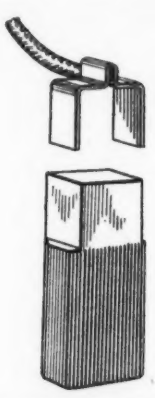
661,731. THERMOSTATIC DEVICE; R. G. Callum, Washington, D. C. App. filed Dec. 30, 1899. Details.

661,732. THERMOSTATIC DEVICE; R. G. Callum, Washington, D. C. App. filed Jan. 9, 1900. Details.

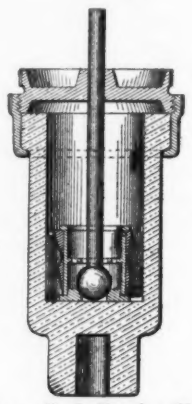
661,736. FIRE ALARM; O. Freymann, New York, N. Y. App. filed Nov. 17, 1899. Details.

661,740. CHIME OF BELLS; H. Kruschwitz, Neu-Nutermhaus, Germany. App. filed May 19, 1899. The bells are electrically operated.

661,742. CIRCUIT CONTROLLER FOR ELECTRIC ENGINES; H. and L. S. Letord, Orlando, Fla. App. filed Feb. 27, 1900. This controller is primarily for dental engines and includes an arrangement of push buttons and simple switches which open and close local circuits to control the main circuit to the engine and the resistance therein.



661,669.—Connecting Conductors to Carbon Brushes.



661,839.—Dash Pot for Electric Arc Lamps.

661,771. ELECTRIC CIRCUIT BREAKER; B. P. Rucker, Philadelphia, Pa. App. filed June 25, 1900. A switch adapted to be automatically operated by an abnormal current to break the circuit, and a switch adapted to break the circuit at another point and by means of which the automatically operated switch is caused to close the circuit.

661,820. ELECTRICAL APPARATUS; M. Schutner, Nyack, N. Y. App. filed June 16, 1900. This is a chair especially for barber's purposes, fitted with electric appliances for administering a current to the head or other portions of the body of a person occupying the chair.

661,839. DASH POT FOR ELECTRIC ARC LAMPS; T. E. Adams, Cleveland, Ohio. App. filed May 7, 1900. This dash pot is made of earthenware and the piston of graphite for the purpose of avoiding expansion and contraction under changes of temperature.

661,880. ELECTRIC BRAKE CONTROLLER; J. C. Lincoln, Cleveland, Ohio. App. filed Oct. 2, 1899. The switch is constructed so that current may be sent from the trolley through the fields of the motors to avoid waiting for the field to build up from the armature current. The switch also will continue the trolley current through the fields after the motors cease to generate and thus hold the car on a grade.

661,881. ELECTRIC METER; Charles William Godson Little, of Heckington, England. App. filed Sept. 4, 1900. (See Current News and Notes.)

11,782. TRAVELING CONTACT FOR ELECTRIC RAILWAYS; Thomson-Houston Electric Company, of Boston, Mass. Original No. 495,443. App. for reissue filed Sept. 28, 1900. (See Current News and Notes.)

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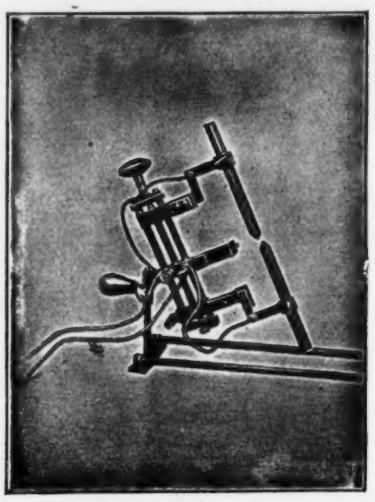

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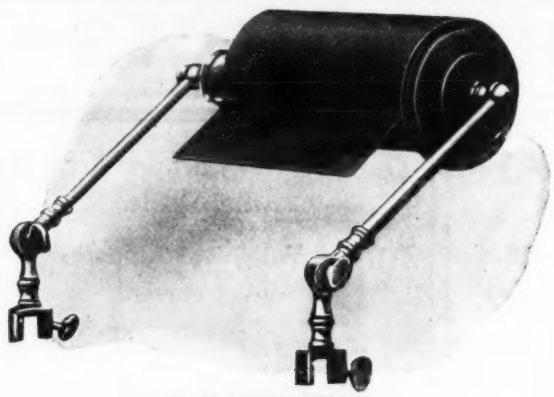

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(Taken from the Army and Navy Magazine.)

An exhibit at the Paris Exposition showing ingenuity and skill in its compilation was that of the Pacific Electric Company of La Crosse, Wisconsin, in Group V, Class 25, consisting of incandescent desk lamps. There, they showed goods of this character in the many different patterns and designs for which their products are noted—in fact they far surpassed many similar kinds of foreign manufacture shown in the same group. Americans who sawthis exhibit could not but feel proud of the display of the company, for it showed to all visitors what an enterprising firm can do when it tries and what kind of products they can produce for their patrons.

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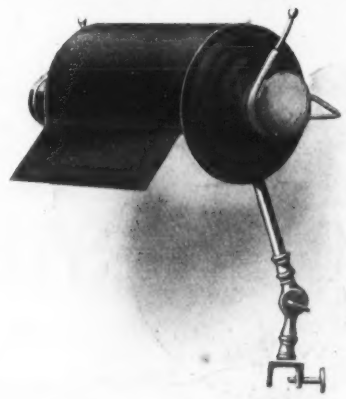

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QUALITY OF LIGHT
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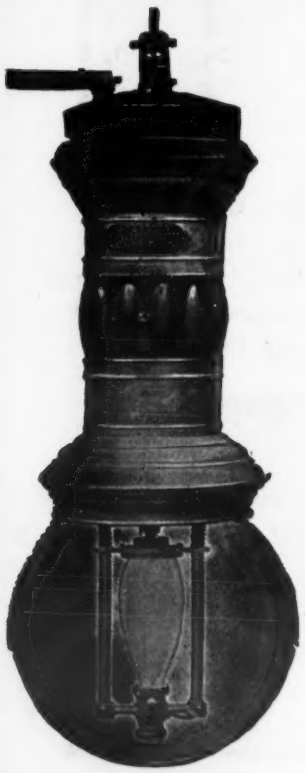

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